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CONTRIBUTIONS TO THE TERTIARY PALEONTOLOGY OF NORTHERN PERU:

Part I, Eocene Mollusca and Brachiopoda

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PREFACE

This paper dealing with certain new or otherwise interesting Eocene mollusks is the first of a series of Contributions to the Tertiary Paleontology of Northern Peru. These studies are principally based upon fossil collections and field observations made during several years of reconnaissance and detailed geologic and stratigraphic investigations for the International Pertoleum Co. Ltd., under the direct and able supervision of its Chief Geologist Dr. O. P. Hopkins. It is also with pleasure that I acknowledge the assistance received from the other members of the Geologic staff at Negritos, namely to Mr. A. Iddings, formerly in charge of the Geologic Office in Negritos and to Messrs O. D. Boggs, G. Boughton, J. Stewart, J. L. Stauft, E. N. MacCormack, E. W. Berry, V. Culbert, and E. Emendorfer.

The geology and stratigraphy of the area has recently been described by Iddings and Olsson in an article published in the Bulletins of the American Association of Petroleum Geologists Vol. 12. No. 1. The student will find in this paper the columnar section of the Tertiary rocks of Peru and the formational names used in the description of the fossil fauna. This information is released for publication through the permission of the International Petroleum Co. Ltd.

Ithaca, N. Y.

January, 1928.

INTRODUCTION

The literature of the 19th century, dealing with the paleontology of the Tertiary rocks of northern Peru, is extremely meager and gives little or no information as to the age and character of the Tertiary deposits of the region. The first fossils to be described from this region were obtained by d'Orbigny[1] who made collections of both recent and fossil mollusks at Paita. His collections of Paita fossils consists mainly of Pleistocene shells from the Tablazo beds exposed so well along the top of the high sea-cliffs east and south of the town. The lot however included an imprint of a Rostellaroid shell which he named *Rostellaria gaudichauai.* This species has the distinction of being the first fossil to be described from the true Tertiary rocks of Peru, and we now know that it came from certain sandstones of Upper Eocene age.

Señor A. Raimondi during his extensive geographic exploration in the Peruvian Republic had obtained large collections of fossils but principally from the older rocks. These collections were submitted to Wm. M. Gabb[2] for study and in 1869 there appeared the first of the two papers dealing with their description. In this article additional Pleistocene fossils are described from Paita along with two species from the same locality obtained by Professor Orton. Orton's shells which were named *Ampullina ortoni* and *Cerithium læevisculum* are common Upper Eocene fossils and doubtless came from the Paita Saman sandstones which previously had yielded d'Orbigny's *Rostellaria gaudichaudi.* Because of the association of living and extinct species, Gabb placed the age of the Paita fossils as Pliocene but noting the difference in enclosing matrix, he also suggested that the fossils may have come from rocks of different ages.

[1] 1842— D'Orbigny, Alcide. Voyage dans l'Amérique Méridionale, Paléontologie at Géologie. Vol. 3, Pt. 3, 4.

[2] 1869—Gabb, W. M. Description of a new species of South American fossils. Tertiary. American Journal of Conchology. Vol. 5, Pt. 1, p. 25.
1877.—Gabb, W. M. Description of a collection of fossils made by Dr. Antonio Raimondi in Peru. Journ. Acad. Nat. Sci. Phila. new series, Vol. 8, pt. 3, p. 263.

About the same time as Gabb's article on the Paita collection, E. T. Nelson,[3] in a graduation thesis, published an account of some fossils from Zorritos. Nelson made no special age determination, other than late Tertiary as suggested by the title of his paper.

In 1889, there appeared Grzybowski's[4] account of a geologic reconnaissance from Paita to Tumbez. In this paper, there is given for the first time, a description of the Tertiary rocks of northern Peru, and an attempt at their stratigraphic subdivision. Grzybowski's paper is principally valuable for his work in the Zorritos region, definitely establishing the Miocene age of the Zorritos rocks. Owing probably to insufficient paleontologic information, he failed or erred in his intrepretation of the geology and age of relationship of the rocks at Paita and Talara.

Outside of Adams'[5] brief reconnaissance through La Brea and the Chira valley, it remained until 1920 and 21, before anything further of note was published on the Tertiary mollusks of the region. H. Douvillé[6] in a series of papers dealing with certain fossils collected at Negritos and submitted by Señor C. I. Lisson of Lima, was able to prove the occurrence of Eocene rocks in the Peruvian littoral. Several of the commonest and most characteristic of the Peruvian Eocene gastropods were described in these papers, including the *Aulacodiscus lissoni*, and *Pseudoglauconia lissoni,* these two species representing new generic types.

The appearance of Bosworth's[7] Geology of North West Peru and its included Paleontological studies by Woods, Vaughan and Cushman marked a great advance in our knowledge of the Tertiary rocks of the region. It was preceded by several years of field studies by Bosworth and his assistants and proved the existence of a very thick and generally fossiliferous Tertiary section.

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[3] 1870—Nelson, E. T. On the molluscan fauna of the late Tertiary of Peru. Trans. Conn. Acad. Sci., Vol. 2, p. 186.

[4] 1899.—Grzybowski, J. Die Tertiarablagerungen des nordlischen Peru und ihre molluskenfauna. Neus Jahrbuch, Beilageband, Vol. 12.

[5] 1909.—Adams, G. I. An outline review of the Geology of Peru. Smithsonian Report for 1908.

[6] Douvillé, H. Compte Rendu Acad. Sci. vol. 171, p. 1345.
1920.—Douvillé, H. Compte Rendu somm. Soc. géol. France, No. 14, p. 193.
1921.—Douvillé, H. Journ. Conchyl. vol. 66, p. 1.

[7] 1922.—Bosworth, T. O. Geology of the Tertiary and Quarternary period of North-west Peru, with an account of the Paleontology by H. Woods. T. W. Vaughan, J. A. Cushman and others.

Spiekes's[8] monograph of the Zorritos Miocene fauna appeared about the same time as Bosworth's work on the older Tertiaries. It gives a rather full account of the Paleontology and Stratigraphy of the Zorritos formation.

STRATIGRAPHY

The Tertiary rocks of Northwestern Peru have an aggregate thickness of fully 25,000 feet and of this total, the lower 15,000 feet belong to the Eocene. For a description of the general Tertiary section, or the Oligocene and Miocene strata, the reader is referred to Bosworth, Spieker or to a more recent paper by Iddings and Olsson[9]. In this latter article, mainly on basis of detailed field studies since 1921, the Tertiary rocks are grouped into 13 formations and their areal distribution is briefly outlined. In the present article, only the Eocene or the lower part of the Peruvian Tertiary column will be discussed.

In Bosworth's classification, the lower Tertiaries are divided into the Negritos and Lobitos formations. He further subdivided his Negritos formation into two series named from their most distinctive fossil genera, the Turritella and Clavilithes series. These formations are very comprehensive and include beds ranging from the Lower Eocene to the Upper Oligocene and moreover contain several unconformities of regional character. For this reason they have been further subdivided through more detailed work. Bosworth's Negritos formation has been restricted to include only the rocks actually exposed at Negritos, namely the Lower Eocene or his Turritella series. For the Clavilithes series, the formational names the Salina, Pale Greda and Parinas have been adopted.

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[8] 1922.—Spieker, E. M. The Paleontology of the Zorritos Formation of the North Peruvian Oil Fields, The Johns Hop. University Studies in Geology, No. 3.

[9] 1928.—Iddings and Olsson, The Geology of North West Peru, Bulls. Amer. Assoc. of Petroleum Geologists, Vol. 12, No. 1.

The Lobitos formation as this term was used by Bosworth is primarily a lithological division and intended to include the rocks lying above the Parinas sandstone and below the highly fossiliferous Zorritos Miocene. It included in its lower part, beds belonging to the Upper Middle Eocene, whose faunal relations are closely allied to the Parinas and lower formations. This set of rocks, largely shale in the Negritos area but changing to sandstones and even to conglomerates further north, has been named the Restin formation, its type exposures being selected from Restin near Cabo Blanco.

The close of the Mid-Eocene was marked by important crustal movements, resulting in elevation and erosion of the earlier formed Eocene rocks. This was followed by renewed deposition in a more extensive scale than previously and the new transgression carried marine waters far beyond its former limits. An erosional unconformity of the first magnitude therefore marks the base of the Upper Eocene and these rocks are found on any of the older beds including the Cretaceous, or the slates and granites of the mountains.

The Upper Eocene rocks also included in the Lower Lobitos by Bosworth, have been named the Saman formation from their typical and highly fossilferous exposures at Casa Saman in the Chira valley and about 10 miles Northwest of Sullmana. The Upper Eocene seas brought the introduction of a new fauna, including the first appearance of the Nummulitic and Orbitoidal foraminifera in the Peruvian section, and this fauna continued in a modified form through most of the Oligocene. On the other hand, the relations of the Saman fauna with the older Eocene is comparatively less pronounced.

The divisions of the Peruvian Eocene as used in this article, are as follow:

<table>
<tr><th></th><th><i>American Time Sub-divisions</i></th><th colspan="2"><i>Formations</i></th><th colspan="2"><i>Bosworth's divisions</i></th></tr>
<tr><td rowspan="6">EOCENE</td><td>Upper</td><td colspan="2">Saman</td><td colspan="2">Lobitos formation</td></tr>
<tr><td rowspan="4">Middle</td><td>Restin</td><td rowspan="2">Parinas Group</td><td rowspan="4">Negritos formation</td><td rowspan="4">Clavilithes series</td></tr>
<tr><td>Parinas</td></tr>
<tr><td>Pale Greda</td><td rowspan="2">Salina Group</td></tr>
<tr><td>Salina</td></tr>
<tr><td>Lower</td><td colspan="2">Negritos</td><td colspan="2">Turritella series</td></tr>
</table>

THE LOWER EOCENE

THE NEGRITOS FORMATION

The Negritos formation has an exposed thickness of about 1,500 feet, but an additional 4,000 feet has been penetrated in well borings. The Upper 900 feet are dominantly sandy, with interbedded impure sandstones, pebble beds, shales and impure glauconites, while the underlying rocks are mainly shales.

The sandy member at the top of the formation, is generally highly fossiliferous, and it is from these rocks that the rich Negritos fauna has been principally obtained. This fauna is very distinctive. It is specially characterized by a group of large *Mesalia*-like *Turritella,* centering around the *T. negritosensis* Woods and suggested to Bosworth the name Turritella series which he adopted for this group of rocks. There are several species which do not occur in the overlying beds namely the *Aulacodiscus lissoni* H. Douvillé; *Peruluta peruviana* H. Douvillé typical form; *P. crassiscula* H. Douvillé; *Pseudolvia mutabilis* Woods typical form; *Melanatria dimorphica* Woods. *propinqua* Woods; *Bezanconia pupoidea* Woods; *Cerithium chatwini* Woods; *Ostrea buski* Woods; *negritensis Leda ingens* Woods and *Venericardia planicosta* var. *negritensis* n. var.

THE MIDDLE EOCENE

THE SALINA FORMATION

The Salina formation which forms the lower part of Bosworth's Clavilithes series has a thickness of about 800 feet. The rocks are dominantly sandy and resemble closely the upper member of the Negritos formation and are best distinguished paleontologically. Fanually the change from the Negritos formation is abrupt and there are no transitional beds between the two formations. The base of the Salina rocks is usually a conglomerate or a series of conglomeritic lenses varying considerably in thickness along the strike. It is believed that this zone marks an unconformity or disconformity and the time interval represented of sufficient duration to have allowed of considerable change in the fauna of the two groups of rocks. This Middle Eocene fauna continued in but a modified form through the rocks which Bosworth called the Clavilithes series. Aside from the Fusoid genus *Clavilithes* which seems to be absent from the older beds we find a new series of *Turritella* grouped about *T. bosworthi,* the peculiar Melanoid *T. anceps* and *annectans* Woods, *Pseudoliva mutabilis* var. *woodsi* n. var. *P. parinasensis* Wood *Melanatria acanthica* and *venusta* Woods, and *Venericardia planicosta* var: *parinensis* n. var.

Comparatively few species seem to be strictly limited to the Salina formation. *Turritella anceps* and *bosworthi* of Woods, *Diplodonta ? dissona* n. sp., *Pseudoliva mutabilis* var, *woodsi* n. var. and a few others are most common in this formation. The *Aturia cf. ziczac* Sby., is found only on the conglomerate zone at the base of the formation.

THE PALE GREDA FORMATION

The Pale Gredas are mainly a lithilogical division and consis of 2,000 to 2,500 feet of yellow, brown or gray shales, lying above the Salina formation and below the Parinas sandstones. Locally thin seams of sandstones and pebble beds may be present and these horizons are mainly interesting since they are usually fossiliferous and have furnished the bulk of the known Pale Greda fauna.

The fauna of the Pale Gredas is rather meager and on a whole does not differ greatly from that of the Salina—Parinas formations. In addition to a few undescribed species of rare occurrence, the following are known only from this formation: *Cerithium boweni* n. sp. *iddingsi* n. sp. and *Eutrephoceras negritensis* n. sp.

THE PARINAS FORMATION

Punta Parinas and the adjacent Punta Balcones, are together the most westerly points of the South American continent. They are formed of rather coarse, gritty, white or yellowish sandstones and pebble conglomerates, collectively known in the Negritos region as the Parinas sandstones or the Parinas formation. They were deposited in very shallow or near-shore waters and often contain large trunks of silicified wood, usually closely riddled with the borings of *Teredo*. Fossil zones are generally confined to the lower and upper part of the formation.

The fauna of the Parinas sandstones is largely that of the general Clavilithes series. It also contains a few special species of its own and a still larger proportion of new forms which continue into the overlying Restin. Species most characteristic of the Parinas sandstones are *Carolia (Parinomya) parinensis* n. sp., *Grateloupia peruviana* n. sp., *Pitaria parinensis* n. sp., *Turritella keswickensis* n. sp., *Telescopium parinense* n. sp., New forms beginning in the Parinas sandstones and continuing into the Restin, or even higher rocks include most of the common species such as *Turritella annectans* Woods (also in Upper Pale Gredas), *Morgana magma* Woods, *Clavilithes pacificus* Woods, *Amotapus arbolensis* Woods, *Cardium restinense* n. sp., *Clementia parinensis* n. sp. and *Corbula parenasensis* Woods.

THE RESTIN FORMATION

In the Negritos region, the Parinas sandstones are generally overlain by gray or olive colored shales varying considerably in thickness according to locality. The shales may contain small foraminifera but other fossils are rare or limited to local zones near the base of the formation. North of Negritos, the Restin shales have become interbedded with sandstones and are thicker and more generally fossiliferous. Still further north they are the basal Tertiary rocks and along the west side of the mountains represent mainly coastal sandstones and conglomerates.

The Restin fauna is closely related to that of the Parinas but is still more highly diversified, due to the appearance of new forms which become more common and characteristic of the Upper Eocene and later faunas. The following species are known only form the Restin formation. *Carolia peruviana* n. sp., *Anomia septanaria* n. sp., *Corbula* (*Cuspicorbula*) *busera* n. sp.,*Clementia restinensis* n. sp., *Cerithium xenium,* n. sp., *Architectonia jabonillensis* n. sp., *Hercoglossa peruviana* Berry and *"Echinocyamus" intermedius* Hawkins.

THE UPPER EOCENE

Upper Eocene rocks are widely distributed in the Tertiary area of North West Peru and include the bulk of the beds belonging to the lower half of Bosworth's Lobitos formation. They • vary considerably in lithology from coarse sandstones, conglomerates, coquina-like beach limestones to massive black shales. Collectively they are grouped together in the Saman formation, named from their most typical and highly fossiliferous exposures found in the Chira valley at Hacienda Cusa Saman near Sullana.

As previously noted, the Saman rocks are everywhere strongly unconformable on the older beds. In the Negritos region, they rest upon the Restin formation or the Upper Middle Eocene. To the south they overlap upon the Cretaceous or older mountain rocks and represent the basal portion of the Tertiaries in that region. This unconformity at the base of the Upper Eocene is the most important stratigraphic break in the whole Teritary section of northern Peru.

The transgression of the Upper Eocene sea was of wide extent and Saman rocks were therefore deposited over a considerably larger area than the earlier Eocene formations. It brought a new fauna from which many of the most characteristic of the older Eocene species had dissappeared such as *Pseudoglauconia lissoni* Douvillé and other large Cerithoid shells. The species which had persistent from the earlier beds in some cases disappeared after a short range in the lower Saman, instance *Peruluta peruviana* var. *samanica* n. var., or continued their development and evolution, sometimes becoming very large before finally disappearing at the close of the Saman. To this class belong such species as *Venericardia planicosta* var *samanica* and *Amotapus* (*Perna* of Woods) *arbolensis* Woods. With the exception of the above but very conspicuous elements, the Saman fauna is largely a new development which persisted through the Oligocene but disappeared before Miocene times. The Saman and related Oligocene faunas are therefore to a certain extent a unit fauna which flourished between Middle Eocene and Miocene times.

The Nummulitic and Orbitoidal foraminifera are entirely lacking from the Lower and Middle Eocene rocks in Peru but immediately assume an important role in the Saman and Lower Oligocene formations. *Orthophragmina peruviana* Cushman and more rarely a stellate species occur only at the base of the Saman rocks associated with a special fauna of mollusks, echinoids and the brachiopod *Liothyrina peruviana* n. sp. This zone marks a very constant horizon which has been traced from Negritos north to Caleto Mero or a distance of more than 60 miles. It is sometimes represented by sandstones and conglomerates which have been called the Saman conglomerate but in many cases the base of the Saman rocks are shales overlying the Restin shales.

The Saman molluscan fauna is very rich and varied. At the base of the Saman or horizon of the Saman conglomeratte there are several species limited to this horizon. They include such shells as the *Polinices woodsi* n. sp. *Epitonium pervianum* n. sp., *Clavilithes pozœnsis* n. sp., *woodringi* n. sp., and *lagunitensis n. sp.*, *Lyra sabulosa* n. sp., *Cassidea maccormaki* n. sp., *Ovula negritensis* n. sp., *Cypraea boffsi* n. sp., and *Liothyrina peruvianum* n. sp. In the higher beds and more particularly in the Saman sandstones of the Chira valley, near the top of the Upper Eocene the following species are quite common: *Venericardia planicosta* var. *samanica* n. var., *Amotapus arbolensis* n. sp., *Arca sullanensis* Woods, *Ostrea samanensis* n. sp., *Spisula callistoides* n. sp., *Cardium samanicum* n. sp., *Lucina paytensis* Woods, *Pseudoliva parinasensis* var. *samanica* n. var. *Dientomochilus gaudichaudi d'Orbigny*, *Cerithium laevisculum*

Gabb, *Telescopium peruvianum* Woods and *samanensie* n. sp., *Turritella boughtoni* n. sp., and *Dorsanum lagunitensis* Woods. Among the common fossils of the Saman rocks but ranging widely in the Oligocene we may mention the *Peruluta mancorensis* n .sp., *Xancus peruvianas* n. sp., *Architectonica sullana* n. sp., *Turritella chira* n. sp., *samanensis* n. sp., *Clementia peruviana* n. sp., and *Aturia alabamensis* var. *peruviana* n. var.

CORRELATION

The occurrence of species of *Orthophragmina* in the basal portion of the Saman formation definitely correlates these rocks with the Upper Eocene and equivalent to the St. Bartholomew limestones of the Lesser Antilles and the Ocala limestones of Florida. Contributing evidence in support of the correlation is furnished by the Saman mollusks and other fossils. In this connection the range of the group of *Venericardia planicosta* through the Peruvian Eocene is of considerable interest. It is a common fossil first appearing as variety *negritensis,* a strongly ribbed form in the lowest fossiliferous members of the Negritos formation. In the overlying Clavilithes series, the shells are more convex with the sculpture becoming smooth on the ventral portion of the shell. These shells belong to the variety *parinensis* and find their closest parallel in the smooth varieties of *V. planicosta* in the Middle Eocene or Clabornian rocks of the southern United States. The group reached its fullest development in the Saman rocks as variety *samanica.* It is a large thick shell with wide, heavy hinge and a smooth sculpture except on the umbos and early part of the shell disk. It represented the last of the *planicosta* group and became extinct at the top of the Saman formation, thus marking the upper limit of the Eocene series.

Several common Saman mollusks belong to genera or sections most characteristic of the later Tertiary faunas. To this class belongs the *Arca sullanensis* Woods, a large *Argina*-like species; large *Trigoniocardia* exemplified by *Fragum samanicum* and one or more undescribed species, a group previously known only from the Oligocene or younger rocks and specially common in the Miocene and recent faunas; the *Clementia peruviana* n. sp., the forerunner of the Miocene *Clementia dariena* Conrad to which it is very closely related; *Xancus peruviana* n. sp., a genus hitherfore not known earlier than the Vickburg Oligocene and common in the Caribbean Miocene; and the *Polinices woodsi* n. sp., a species belonging to the typical section and very close to the *Polinices subangulata* Nelson of the Zorritos Miocene and the recent West Coast *Polinices alveatus* Troschel.

Two species of the Cephalopd genus *Aturia* occur in the Peruvian Eocene. The earlier species, found only at the base of the Salina formation, appears to be most closely related to the *Aturia zic-zac* Sowerby from the Londinien or Upper Eocene of England. A second species of *Aturia* is found in the Saman Eocene and continues through into the Upper Oligocene. This species is often quite common and scarcely distinguishable from the *Aturia alabamensis* Morton from the Claiborne and Jackson beds of the southern United States.

Attention has already been called to the occurrence of the brachiopod *Liothyrina peruviana* in the Saman conglomerate. Related species occur at the same horizon associated with species of *Orthophragmina* in Colombia, in the San Fernando beds of Trinidad and the St. Bartholmew limestones.

DESCRIPTION OF SPECIES

Family PINNIDÆ Meek

Genus ATRINA Gray

Atrina talarensis, n. sp. Plate 4, fig. 3

Shell small to medium size, thin, moderately convex; the greatest convexity is situated in the anterior region, where a cross-section would show nearly a perfect circle; hinge-line straight while the lower or ventral margin appears to be slightly incurved; shell substance very thin, ornamented with longitudinal ribs or elevated lines which show on the inner surface as grooves and become impressed on the internal casts; the longitudinal ribs are low but nearly equal and regular, and number about 13 or 14 on the type specimen, and about midway between the anterior and posterior extremities, they are spaced about 1 1/2 mm. apart; the longitudinal ribs were probably somewhat spiny or nodose, especially near the posterior submargins; a band along the ventral submargins averaging about 5 mm. in width is smooth.

Length 53mm; height 40mm; diameter 24mm; fragmentary specimen

Remarks.— Although this species is fairly abundant at its type locality, specimens are always fragmentary, represented mainly by internal casts. It appears to be a small or medium-sized species reaching a maximum length of from 70 to 80 mm.

Locality and Geologic Occurrence.— Saman formation, Talara.

Superfamily OSTRACEA Goldfuss

Family OSTREIDÆ Lamarck

Genus OSTREA Linné

Ostrea negritensis, n. sp. Plate 2, figs. 4, 5, 6

Shell small or medium-sized, rarely exceeding 60 mm. in length; the lower left valve convex and rather heavy, typically ostroid or in some cases strongly exogyroid in form, this latter condition being due to an exaggerated or greater coiling of the beaks; surface of the left valve generally smoothish, but with evident but nearly obsolete radial folds or ribs; the interior of the left valve shows a curved or slightly coiled, ligamental area, directed posteriorly and passing into or under the beaks, most pronounced in the exogyroid shells; anterior and posterior internal margins of the shell strongly and regularly punctate or crenulated.

Length or width 35mm;	height 59mm;	diameter (left valve) 30mm
32mm;	height 52mm;	28mm

This is an interesting species found only in the Lower *Turritella* beds of Negritos. All the specimens in our collection represent the left valves, so that the characters of the upper or right valve are not known. From the *O. buski* Woods, with which the species is associated, it is recognised by its curved or posteriorly directed ligamental area, and by its nearly smooth shell.

Ostrea negritensis shows much variation in the extent of coiling of its beaks, and in some cases this condition is carried to such an extreme that were the shells found in Cretaceous sediments, they would be classed as a species of *Exogyra* without hesitation. However this character is very variable and all gradations to typical Ostroid shells may be found. It is significant however that *O. negritensis* is found only in the lowest exposed fossiliferous rocks of the Peruvian Tertiary and belong to the Lower Eocene. The European literature contains records of *Exogyra* as high as the Miocene.

Formation.— Negritos formation, Negritos.

Ostrea samanensis, n. sp. **Plate 1, figs. 1, 2, 3, 4, 5**

Shell medium to large; young shells are usually subcircular in form, but become oblong or elongate with age; valves unequal, the lower or left valve usually convex and sculptured with strong, subregular, sulcated, radial ribs; the upper or right valve of less convexity or sometimes flat, smooth or sculptured only by the concentric growth lines; the beak of the lower valve when perfect is usually strongly curved or Exogyroid, with a small or large area of attachment; in old shells, the radial ribs of the left valve usually become obsolete and the lower half of the shell tends to be smooth, except for the lamellations caused by the growth lines; texture of the shell of medium thickness except in very large shells; the hinge of the left valve shows a curved ligamental area, while in the right valve, the ligamental area is more nearly straight.

Height 52mm; width 44mm; diameter 25 mm; (Holotype)
57mm; width 42mm; diameter 19mm lower valve;
8[illegible]mm broken; width 57mm; diameter 30mm lower;
88mm; width 36mm; diameter 23mm upper

This species bears some resemblance to the *Ostrea sellæformis* variety *lisbonensis* Harris from the Lower Claiborne or St. Maurice beds of the Louisiana, but differs typically by its more strongly coiled beaks and by its greater convexity of form. The lower or attached valve is strongly ribbed or costate, and the upper valve is flat and simply sculptured with concentric growth-lines. It is a common species throughout the Peruvian Upper Eocene.

Locality and Geologic Occurrence.— Saman formation, type specimens from Casa Saman, but common throughout the Saman Eocene.

Superfamily ANOMIACEA Hermannsen

Family ANOMIIDÆ Gray

Genus ANOMIA Muller

Anomia septenaria, n. sp Plate 2, figs. 2, 3

Shell of medium size, averaging about 35 mm. in height and length but sometimes growing to a larger size; the upper or left valve is convex, subcircular in form and moderately heavy in texture; surface typically sculptured with 7 rather heavy, angular ribs which are regularly spaced and give the shell a *Pecten*-like appearance; these ribs are continued through the shell and show on the internal casts of the fossils; the ventral margins of the shell is strongly scalloped by the ribs, and the two valves fitting closely together; the interspaces between the ribs is wide and generally smooth, or faintly striated by the concentric growth lines; the right valve as preserved in our specimens is flat or slightly concave and somewhat irregular in form and generally smooth; the byssal foramen of medium size and open; internal characters concealed.

Height 40mm; length 44mm;
36mm; length 37mm; diameter 19mm

Remarks.— This is a peculiar shell, quite unlike any species of *Anomia* which I have found described. It is quite common in the Upper Restin sandstones but good specimens are rare and usually only casts with patches of the original shell may be collected.

In two of our specimens, the right valve is preserved, the one showing a medium-sized byssal foramen, and proving the shell to belong to the *Anomiidæ*, otherwise it might easily have passed for a small oyster. The internal characters are completely concealed and the shells are therefore referred only provisionally to the genus *Anomia*.

Localities and Geologic Occurrence.— Restin formation, Que. Salado, Jabonillal, Lobitos.

Genus CAROLIA Cantraine

Subgenus CAROLIA s. s.

Carolia (Carolia) peruviana, n. sp. Plate 2, fig. 1

Shell moderately thin, subcircular in form, or with the height somewhat exceeding the length; left valve slightly to moderately convex, with broad inconspicuous umbo and beak; right valve flat or slightly concave; external surface of valves covered with a fine, sculpture of vermiculate, close-set radial striæ or threads, internal characters concealed.

Height 68mm; length 66mm; diameter of left valve 15mm
50mm; length 45mm; diameter 6mm;

In the true *Carolia*, of which the *C. placunoides* Cantriane from the Egyptian Eocene is the type species, the external surface is sculptured much as in *peruviana* with fine, vermiculate radial threads. In this feature, *peruviana* also resembles *C. jamaicensis* Dall [1] from the Cambridge beds of Jamaica and considered by Dall as a true *Carolia*. The internal characters by which *Carolia* is best distinguished, are entirely concealed in the specimens at present available for study.

This species largely replaces the *C. parinensis* in the Restin formation and from which it will be recognised by its submicroscopic sculpture referred to above.

Subgenus PARINOMYA n. subg.

Type.—Carolia parinensis, n. sp.

The following is a description of the subgenus *Parinomya*:

Shell in form and general features like *Carolia* s. s., but the exterior marked with a submicroscopic rasp-like or pectinate sculpture, the finer growth lines being drawn out at intervals into teeth-like extensions, radially arranged; resilium internal; interior of right valve with a large chondrophore which as in *Carolia* s. s., is seated on the anal or posterior side of the umbo and extends adorally above the byssal foramen, but remaining free or separate from the dorsal margin by an open slit or cleft; byssal foramen large, open, or closed only by a byssal plug.

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[1] Trans. Wagner Free Inst., vol. 3, pt. 4, p. 776, pl. 33, fig. 21.

Remarks.— Fischer[2] has fully described and figured the internal characters of the *C. placunoides* Cantraine, the type species of *Carolia* s. s., from the Egyptian Eocene. In the young stages, the byssal foramen of the right valve is fully open and *Anomia*-like. With growth, the foramen gradually atrophies and in mature shells, it is completely closed by shelly matter and often hardly discernable as a scar. The chondrophore carrying the resilium, rises from the posterior side of the umbo, extends across the upper edge of the shell, its outer or upper edge becoming fused to the cardinal margin of the shell. The various changes passed through by *Carolia,* in its development, are divided by Fischer roughly into 4 stages, comparable to the adult condition of allied Anomoid genera.

In *Parinomya,* the developmental changes are less complete, the foramen although becoming reduced in size, is persistant and well-marked even in the senile or gerontic individuals. It is generally filled with a close-fitting corneous plug. In addition, the chondrophore does not seem to fuse with the anterior-dorsal margin, but remaining separated by a well-developed slit. The external characters will also help in discriminating this from true *Carolia.*

Carolia (Parinomya) parinensis, n. sp. **Plate 3, fig. 1-4**

Shell of moderate size, subcircular and somewhat irregular in growth; shell substance nacreous, fairly heavy and composed of fine, silvery *Anomia*-like lamellæ; right valve flat or slightly concave, the left valve deeper and evenly convex; in the right valve, the resilium is seated on a large, heavy chondrophore rising from the posterior side of the umbo, and extending adorally above the byssal foramen, but remaining free or separated from the cardinal margin by a deep slit or cleft; byssal foramen of the right valve, circular and generally rather large, remaining open or simply closed by a byssal plug, and situated at a varying distance from the dorsal margin; muscle scar in the right valve, nearly circular, and in old shells generally sunken or surrounded by a thickened margin; the exterior of the shell is usually weathered and the surface is smooth, or strongly lamellos near the ventral margins; in well-preserved specimens, the finer sculpture is rasp-like or pectinate, the finer growth-lines being drawn out at fairly regular intervals into teeth-like extensions; as these teeth-like extensions follow in a fairly regular order, they produce a fine radial sculpture.

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[2] Journ. de Conchyl., 28, p. 345, pl. 12; Man. de Conchyl. p. 933, fig. 700; see also Dall, Trans. Wagner Free Inst, vol. 3, pt. 4, p. 775.

Length 78mm;	height 62mm;	diameter 11m, (right valve, Holotype)
Length 64mm;	height 62mm;	diameter 16mm;
64mm;	height 62mm;	diameter 19.5mm

C. parinensis is a common and characteristic fossil of the Parinas sandstone but also occurring less commonly in the overlying Restin. From *C. peruviana,* it will be recognised by its submicroscopic external markings.

Localities and Geologic Occurrence.— Parinas formation of Parinas and Balcones Points, Keswick Hills, etc. Cabo Blanco sandstones of Cabo Blanco and Cabo Verde.

Restin formation, Jabonillal.

Superfamily MYTILACEA Ferussac

Family MYTILIDÆ Fleming

Genus MYTILUS Linné

Mytilus euglyphus Woods, var. negritensis, n. var. Plate 4, fig.4

Mytilus euglyphus? Woods 1922, Bosworth Geology of North-West Peru, p. 63, pl. 1, fig. 8.

Differs mainly from the *euglyphus* Woods, by its coarser sculpture and in form, the longer axis or the height of the shell being nearly at right angles to its length; the shell is strongly ridged and this line or crest divides the sculpture into two unequal areas; the posterior area is uniformly coarse, sub-regular and unbeaded, but along the margins the ribs become divided into smaller rays through bifurcations or new, small and shorter ribs are introduced; the antero-ventral margin is concave, sculptured with finer beaded ribs; as usual there is a tendency to the formation of a narrow patch without sculpture and lying a short distance below and behind the beaks, but with the resumption of sculpture again just below the beaks; internal characters concealed.

Height 35mm; length 29mm; diameter 8mm right valve

This shell differs from *M. euglyphus* Woods, described from *Clavilithes* beds (Salina-Parinas) in its coarser sculpture and in form. The *Mytilus euglyphus?* Woods figured from the *Turritella* beds may be the same. *Negritensis* should probably have the rank of a full species.

M. euglyphus is compared by Woods to *M.Rigaulti* Deshayes[3] of the Parisian Eocene and referred by Cossmann to the Section *Arcomytilus*. He also compares *euglyphus* with *Modiola Foncki* Philippi [4] from the Tertiaries of Lebu Chile. *M. Foncki* Philippi from Chile is strongly accurate but less so than *negritensis*. *M. euglyphus* var *negritensis* occurs in the Negritos formation, while typical *euglyphus* ranges through the Salina formation into the Parinas and Restin formations.

Family AMOTAPIDÆ n. fam.

Genus AMOTAPUS n. gen.

Type.—Perna arbolensis Woods Plate 4, figs 1, 2, 5

The following is a description of the genus *Amotapus*.

Shell very thin, with deep, regular, *Inoceramus*-like concentric undulations, continued through to the interior of the shell; general form of the shell Pernoid, with the height much exceeding the width; hinge straight, plain, smooth, or simply longitudinally grooved; left valve with a large *Mya*-like chondrophore carrying the internal resilium, and fitting into or under a corresponding socket or depression in the right valve lying immediately below the beak.

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[3] Deshayes. 1862, Descript. Anim. sans Vert., 2, p. 29, vol. 1, pl. 74, figs 23, 24.

Cossmann and Pissarro, 1904-1906, Icon. des coquilles fossiles de l'Eocene des environs de Paris, Tome 1, pl. 37, figs. 112-6.

[4] Philippi 1887, Die Tert. und Quart. Verstein Chiles, p. 204, pl. 43, fig. 1.

Remarks.— The type species of this new genus was described by Woods, as *Perna arbolensis* from a specimen collected by Bosworth from the Parinas sandstones. It first appears in the Parinas formation where the species is always small and the largest specimens which have come to my attention measure about 45 mm. in height. It continues into the upper Eocene, reaching progressively a larger size in the higher rocks, finally disappearing along with the *Venericardia planicosta* var *samanica* at the top of the Saman formation. In the Saman conglomerate, the shells are still small like those from the Parinas formation. In the Saman shales or the Lower Upper Eocene, the largest specimens come from Caleta Sal, the average size being about 55 mm. in height, but in the Saman sandstones of the Chira valley, at the top of the Upper Eocene, the shells are very large, often exceeding 100 mm. in height.

The general shape of the shell is very similar to *Pedalion* (*Perna* or *Melina*), and upon the external form alone, this would be the relations at once suggested. The shell substance is thin and sculptured with regular concentric waves or undulations, and this sculpture as in *Inoceramus,* is continued through to the interior of the shell, becoming impressed with nearly equal intensity upon the internal casts. The shells of the typical Pernas are usually smooth, sometimes very heavy, are ribbed in the section or subgenus *Mulletia* Fischer , but forms concentrically sculptured are rare or unknown. It is however in the hinge characters that the form departs widely from the *Pernidæ* and apparently from other Monomyarian families.

In most cases the fossils are found as internal sandstone casts with only patches of the very thin shell still remaining. In these casts, the hinge is usually buried under the closely adjacent beaks or if exposed badly worn or weathered. By breaking away the right beak of small well-preserved specimens from the Parinas sandstones, the hinge is sometimes exposed for study. These specimens show a smooth, hinge-line devoid of the serial ligamental pits of the *Pernidæ*, and the left valve provided with a fairly large, flat or Mya-like chondrophore fitting into a corresponding depression under the beak of the right valve. In the larger specimens from Caleta Sal, the hinge is sometimes partly preserved, with remains of the large, but much weathered chondrophore. These specimens from Caleta Sal are of value in showing that the possession of a chondrophore is a constant and persistant character.

Order ANOMALODESMACEA Dall

Superfamily ANATINACEA Dall

Family THRACIIDÆ Dall

Genus THRACIA Leach

Thracia staufti, n. sp. **Plate 9, fig. 1**

Shells of medium size, thin elliptical to subcircular in outlines; in the typical form, the shell is ellipitical with the posterior side wide and about twice as long as the anterior; anterior end contracted, depressed and relatively short, and with the extremity subtruncate; beaks small pointed and directed slightly anteriorly; convexity of the valves is slight, that of the right being generally greater, while the left may be flat or depressed; ventral margin well-rounded; the posterior-dorsal margin straight, and more or less parallel to the anterior side of the ventral margin; substance of the shell is very thin, irregularly, concentrically undulate or plicate, and in addition the surface is covered with a fine sculpture of small granules, arranged in close-set radiating lines; hinge not preserved.

Length 42mm; height 28mm.

Remarks.— This species occurs quite abundantly in the Upper Restin sandstones of Quebrada Conventos between LaBreita and Fernandez of the Upper Mancora valley. The typical form is generally sub-elliptical or subovate, but possibly due to crushing certain other shells have a subcircular outline.

Without the contributing evidence of hinge characters, the present species has been referred to the genus *Thracia,* mainly on its general form, and fine submicroscopic granulation of its valves. The shells also appears to have been originally non-nacreous which would exclude it from the *Periplomatidæ.*

A similar species has been described by Cossmann and Peyrot as *Thracia* (*Cyathodonta*) *Dollfussi,* from the Miocene of the Aquitanien Basin in France. The European shell is more equilateral, with stronger concentric ripples, which are however strictly concentric and not oblique as in the typical *Cyathodonta*. The *Periploma collardi* Harris from the Lower Claiborne is similar to the more circular shells, but possesses a pearly shell and is a true *Periploma*.

Locality and Geologic Occurrence.-- Restin formation, Que. Conventos.

Order TELEODESMACEA Dall

Superfamily CARDITACEA Menke

Family CARDITIDÆ Gill

Genus VENERICARDIA Lamarck

Venericardia (Venericardia) planicosta Lamarack (group)

Venericardia planicosta Lamarck (group) Woods 1922, Bosworth Geology of North West Peru, p. 66-70, Pl. 3, figs. 2, 3, pl. 4, figs. 1-3.

The well-known *Venericardia planicosta* was described by Lamarck in 1801, as a Lutetian or Middle Eocene fossil from the Parisien Basin. It is however in the west Atlantic or eastern Pacific region, where the *planicosta* group reached its acme of development and as fossil occur throughout the marine Eocene along both the east and west coast of North America. They constitute our most characteristic and reliable guide fossils for the marine American Eocene.

In Peru, the members of the *planicosta* group are abundant fossils through the entire Eocene section. Beginning in the lowest exposed, fossiliferous members of the Negritos formation (*Turritella* beds) of Lower Eocene age, they continue uninterruptedly through to the top of the Saman sandstones of the Chira valley and Paita. Although a part of the Upper Eocene fauna may continue into the overlying rocks referred to the Oligocene, the group of *Venericardia planicosta* does not pass above the Saman formation.

In their range from the Lower to the Upper Eocene, several mutations or varieties are developed, and Woods in his work on the Bosworth collection, has figured and described, the principal forms occurring in the lower and middle portion of the section. In general these varieties have a limited stratigraphic range, and as their characters are quite constant, they are entitled to at least subspecific recognition. In general the Peruvian shells differ from the typical European type and its subspecies from other regions, in having a less number of ribs, generally between 22 to 24. The

Peruvian subspecies and their range is as follows:

1. var. *negritensis,* Negritos formation (*Turritella* Series) Lower Eocene
2. var. *parinensis*, Salina to Parinas formation (*Clavilithes* Series) Middle Eocene
3. var. *restinensis,* Restin formation. Upper Middle Eocene
4. var. *samanensis,* Restin and Saman formation. Upper Eocene

Venericardia planicosta var negritensis, n. var. Plate 5, figs. 1, 2

Venericardia planicosta Lamarck (group) Form A. Woods, 1922, p. 66, pl. 4, fig. 1

Venericadia, sp. Woods, 1922, p. 69, pl. 4, fig. 4.

This variety is the common and characteristic type in the Negritos formation. The usual form is obliquely subtrigonal with low, flattened umboes and with erect or but slightly curved or inclined beaks. The shells are but slightly convex, sometimes appearing flattened or depressed especially near the ventral or basel margins. The sculpture is strong, with relatively few, heavy persistant ribs, widening out very noticeably towards the ventral margins. On the umbos, the ribs are high and narrower than the deep, groove-like interspaces, but they broaden rapidly and near the ventral margin, flatten and become 5 or 6 times the width of the shallow but distinct interspaces. From the anterior extremity to the umbonal slope, the ribs number from 17 to 19.

The umbonal slope or ridge is usually well-defined, and the sculpture of the dorsal-posterior submargins is quite different from the rest of the shell disk. Except in the very earliest stages, the ribbing of the dorsal margins is weak, the ribs quickly fading out distally, and the surface becoming smooth or sculptured simply by crowded growth lines. The low ribs of the posterior-dorsal submargin number 4 or 5, so that the total number of ribs over the whole surface is 22 to 24.

Localities and Geologic Occurrence.— Negritos formation, Negritos- LaBrea.

Venericardia planicosta var parinensis, n. var. Plate 5, fig. 3

Venericardia planicosta Lamarck (group) Form B and C, Wood, 1922, p. 67, pl. 3, figs. 2, 3.

This variety begins in the Salina formation, continues up through the Pale Gredas into the Parinas, or characteristic of the group of rocks, placed by Bosworth in his *Clavilithes* series. Usually the earlier forms are but moderately convex, with stronger ribbing extending over the umbos onto the center of the shell disk but fading out rapidly nearer the ventral margins (see Woods's fig. 2). In the Parinas sandstone, the shells are generally larger, heavy, with full convex umbos, curved beaks and a heavy, high hinge (see Woods's figure 3). The sculpture is weak and confined to the umbos and earlier portion of the shell disk, leaving the major part of the surface smooth, except for growth lines. The umbonal slope is rounded as in the Parisien and Claibornian shells, and the dorsal submargins are but feebly differentiated. The ribs number as in *negritensis,* about 17 to the umbonal slope, and 22 to 23 over the whole surface.

In this type we find a close approach to the smoother forms of *V. planicosta* from the Upper Wilcox and St. Maurice horizons of Louisiana and Alabama, designated as variety (gamma) by Harris [5], and to *V. ionensis* Waring [6] (*V. merriami* Dickerson), from Oregon and California. In each case, these smooth *Venericardia* are found in rocks of Middle Eocene age.

Venericardia planicosta var. restinensis, n. var. **Plate 6, fig. 2,**

During the Restin or the Upper Middle Eocene, the conditions for the growth and evolution of this series of *Venericardia,* does not appear to have been specially favorable, and the shells are generally small, rarely exceeding 50 mm. in length. They vary from well-rounded to subquadrate in form, strongly convex with heavy ribs extending over two thirds of the surface, becoming obsolete or fading over the central portion. The ribs number about 17 to the umbonal angle, with 5 or 6 additional ones on the dorsal-posterior submargins. The umbos are full, convex, with small, curved beaks and small deeply sunk lunule. The posterior submargin is somewhat ridged in the middle, bordered with a depressed or concave zone on the outer side.

An interesting *Venericardia,* probably belonging to the *planicardia,* stock was described by Grzybowski [9] as *V. clavidens,* and he lists the fossils both from Zorritos and Rica Playa. From Grzybowski's Zorritos records, one would presume the fossil to be of Miocene age, but the species is not mentioned by Spieker in his studies on the Zorritos fauna, or have any specimens been found in the course of our own extensive collecting in the Miocene rocks of northern Peru. It is therefore most probable that Grzybowski's specimens were collected only at Rica Playa, where Miocene beds are found over-lapping on the Upper Restin and Lower Saman Eocene. *V. clavidens* resembles variety *restinensis* by its small size, and in sculpture, but differs by its strongly pointed posterior extremity and by its hinge. The hinge of *clavidens,* shows in the right valve, a small tooth rising from the posterior end of the nymphs. In this feature *clavidens,* shows an approach to *samanensis,* occupying an intermediate position between that variety and *restinensis,* which its stratigraphic position at Rica Playa, would also indicate.

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[5] Harris, 1919, Bulls. Amer. Pal., No. 31, vol. 6, p. 78, pl. 28, fig. 3, pl. 29, fig. 1.

[6] Waring 1914, Journ. Geol., vol. 22, p. 789; 1917, Proc. Calif. Acad. Sci., ser. 4, vol. 7, No. 4, pl. 11, figs. 1, 2.

Hanna, 1925, Notes on the Genus *Venericardia* from the Eocene of the West Coast of America, Univ. of Calif., Bull. Geol. Dept., Vol. 15, No. 8, p. 284, pl. 36, figs. 1, 2, 4, 4, 6, 7 and 9., pl. 42, figs. 1, 2.

[9] Neues Jahrb. fur Min. etc., Beil. Band vol. 12, p. 636, pl. 19, fig. 1.

Localities and Geologic Occurrence.— Restin formation, Negritos, Pozo valley near Lagunitas and Lower Verdun, Jabonillal, Restin.

Venericardia planicosta var. samanensis, n. var. **Plate 5, figs. 4, 5**
Plate 6, fig. 6

In this variety, we have the final and culminating product of evolution of the Peurvian group of *V. planicosta.* It occurs rarely in the Restin rocks but becomes at once common and typical in the succeeding Saman. The shells are often very large, massive, typically hatchet-shaped with height exceeding the width. They are moderately or strongly convex, with wide, full umbos and strongly coiled beaks (but less than in *parinensis*). The ribbing is strong in young shells and on the umbos of larger specimens, and persists over a larger area than usual in var. *parinensis.* Usually in large shells, the ribbing extends over the upper half, leaving the lower part smooth or simply marked by faint radiating lines representing the faded out ribs and by the growth lines. The usual number of ribs is about 21, those on the posterior-dorsal submargins being low and subobsolete. On the Restin specimens, the ribbing is heavier and persist over a relatively larger area, and the interspaces are deeper and more groove-like (see fig. 4), while the ribbing on the Saman shells is more rounded, and the interspaces are much narrower.

The hinge of the full-grown shell is very wide and massive. Its most striking feature is the development of wide, high and vertically flattened nymphs, which project upward and around which the ligament is attached. This adaptation is a natural one, as the area of ligamental attachment must be increased to care for the increased size and weight of the mature shell. In rare cases, the ligament itself has been preserved, and shows as a large, massive plug, projecting above and in a posterior direction along the dorsal area of two valves. A similar development of the nymphs but to a much less degree, is seen amongst the typical *planicosta* of the Parisian basin[10]. *V. planicosta* from the southern United States, do not show this condition, and the nymphs are relatively small and narrow.

Length 94mm; height 100mm; diameter 65mm; (type) Saman sandstone
75mm; height 80mm; diameter 63mm; Restin specimen

Localities and Geologic Occurrence.— Restin formation; Que. Salado. Saman formation; Horizon of the Saman conglomerate, Negritos, near Lagunitas, etc. Very abundant and large in the Saman sandstone of the Chira Valley, Paita, Bayovar, etc.

Venericardia peruviana, n. sp. **Plate 6, fig. 1**

Shell rather large, inequilateral, broadly ovate or subelliptical in form and with the low beak situated very close to the anterior extremity; posterior side widely rounded, the dorsal somewhat arched, the ventral gently rounded or nearly straight, anterior margin shorter; the shell is moderately convex, greatest just about the center of the disk, the umbos are low and not conspicuous with small, prosogyrate and closely adjacent beaks; the lunule is very small; there is a faint depression or sinu, extending across the dorsal side of the umbos to the posterior margin and serves to separate the faintly sculptured posterior-dorsal submargins from the heavier sculptured surface below; sculpture consists of moderately heavy, V shaped ribs which cover most of the shell surface; on the umbos, the ribs are heavy and strongly V shaped or ridged but become rounded and wider towards the posterior-ventral extremity; the ribs number about 19 from the anterior margin to the faint umbonal sinus, with 5, very faint, additional ribs on the posterior-dorsal slope; interior concealed.

Length 80mm; height 66mm; diameter 41.5mm;

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[10] Catalogue Illustré de la Collection Lamarck. Museum D'Histroire Naturelle de Geneve, Premiere Partie, pl. 23, fig. 126b, pl. 24, fig. 126d Cossmann, 1901, Bull. Geol. Soc. France, vol. 1, p. 652-656, figs. 1 and 2.

Remarks.— There appear to be no closely related species to which this shell need be compared. It differs from the *planicosta* group by its form and V-shaped ribs. The umbonal surface is somewhat weathered in our specimens, but the ribs appear to have been slightly beaded and keeled.

Locality and Geologic Occurrence.— Salina formation, Negritos.

Venericardia pacifica, n. sp. Plate 6, figs. 3, 5

Shell small or moderate size, rounded or subcircular in outlines and rather strongly convex; the beaks are situated about the anterior one fourth; the dorsal margin is straight while the anterior and posterior extremities are well rounded and together with the base or ventral margin form part of a curve which is nearly circular; umbos full and quite prominent with small, slightly prosogyrate, adjacent beaks; lunule very small; sculptured with about 28 ribs (about 19 to the umbonal slope); on the umbos, the ribs are narrow, elevated and beaded, and with deep U-shaped interspaces fully three times the width of the ribs themselves; the ribs change abruptly at a resting mark, and below this point, become wide, flattened or rounded on top and separated simply by incised lines.

Length 41mm; height 42mm; diameter 31mm;

Remarks.— This species occurs with the preceding and from which it is recognised by its circular form and character of its ribs.

Locality and Geologic Occurrence.— Salina formation Negritos.

Family DIPLODONTIDÆ Dall

Genus DIPLODONTA Brown

Diplodonta? dissona, n. sp. Plate 9, figs. 8, 9

Shell lenticular, nearly equilateral, inequivalve; the right valve is moderately convex with wide but not prominent umbos and small inconspicuous beak; the left valve is flat or somewhat depressed in the ventral half and generally slightly flexed towards the left in the anterior portion; the beaks in each valve are small, close, and inconspicuous; the dorsal or hinge margin is rounded, that of the right valve slightly overlapping the left; basal or ventral margin is straight or very slightly rounded; the posterior side is subtruncate, the anterior subtruncate to rounded and the resulting outlines of the shell is subquadrate; there is no lunule or escutcheon but a faint sinus may be present along the left, posterior dorsal margin; surface sculpture consists of fine, regular, concentric threads on both valves; interior of the shell, judging by molds, show a simple and continuous pallial line; hinge unknown.

Length 22mm; height 19mm; diameter 7.75mm;

Remarks.— This species is remarkable in having dissimilar valves, the left valve being smaller, flat or depressed and slightly overlapped by the right valve along the dorsal or hinge margin. In other respects, the shell by its shape and essentially non-Lucinoid anterior muscle scar, has the appearance of a medium-sized *Diplodonta* and for these reasons, I am referring this fossil to the genus Diplodonta, rather than amongst the *Lucinidæ*.

The pallial line as shown on certain internal molds is simple and connected to the base of a circular or ovate, anterior muscle scar and not above as typical of most Lucinas. The hinge is not preserved in our specimens but judging from certain internal molds, there appear to have been no lateral teeth.

This species is quite common in the Salina formation, particular near the base.

Locality and Geologic Occurrence.— Salina Formation, Negritos.

Pale Greda formation, Negritos.

Subgenus RINGICARDIUM Fischer

Cardium (Ringicardium) restinense, n. sp. Plate 11, fig. 1

Shell of medium size, inflated, somewhat auriculate and nearly equilateral; umbos high and prominent, and situated nearly midway between the anterior and posterior extremities; ventral margin evenly rounded with the posterior margin nearly straight or subtruncate; the anterior margin is straight or slightly rounded; the posterior-dorsal slope is depressed or concave and differs from the rest of the shell by its finer ribs; the sculpture consists of fairly wide, flat ribs, separated by narrower, groove-like anterior to the umbonal angle and about 10 on the posterior-dorsal submargins; over most of the surface of the shell, the ribs are flat and smooth; on the umbonal angle and along the anterior part of the shell, the ribs carried small hollow spines, represented on the fossil shells mainly by their broken bases; the edges of the ribs on the posterior-dorsal suhmargins are beaded and the interspaces ocassionally wrinkled or waved.

Length 46mm; height 47mm; diameter 39mm;

Remarks.— This species is closely related to *C. harrisi* Vaughan form the Claiborne of the United States, agreeing most closely with the variety *gainesense* Harris. Direct comparison of specimens show the Claiborne species as being much larger and with fuller umbos.

The subgeneric or sectional relations of this species, as well as *C. harrisi* is doubtful. Dall in a brief review of a number of fossil Cardiums, suggested that *C. harrisi,* might be supposed to belong to *Tropidocardium* Rœmer, except that the shell does not gap. The type species of *Tropidocardium,* namely *C. costatum* Linne is a recent East Pacific shell, with high, ridge-like ribs, a channel interior and posterior gap, features quite different from those shown by either *C. harrisi* or *restinensis.* According to Cossmann, *Tropidocardium* is not known in a fossil state.

The subgenus *Ringicardium* Fischer, type *C. ringens* Chemnitz a recent species, but represented by a number of fossil European shells, has generally flattened ribs, sometimes bearing large spines, an inflated and often subauriculate shell. The posterior extremity is gaping and but partially closed by spine or tooth-like projections of the ends of the posterior set of ribs. In *restinensis* and *harrisi* there is no posterior gap, the valves fitting closely all around. On the other hand, the *C. procerum* Sby, a fairly common shell along the Pacific coast of Peru, is generally referred to *Ringicardium.* In this species, the gap is very small and the tooth-like extension of the ribs is very slight.

Localities and Geologic Occurrence.— Restin formation, Restin, Jabonillal, Pozo valley etc.

Subgenus FRAGUM Bolten

Section TRIGONIOCARDIA Dall

Cardium (Trigoniocardia) samanicum Dall Plate 11, fig. 2

Shell solid, high, convex and truncate behind; umbos high and prominent and with the greatest convexity of the shell about the center of the shell disk; ventral and anterior margins evenly rounded; the posterior margin is straight and meeting to form nearly a right angle with the basal margin; the posterior-umbonal slope is angled, with a slight sinus or depressed band lying just in front; the posterior-dorsal submargins are depressed or concave but rising again to form a broad ridge along the valve margin; sculpture consists of heavy, ornamental ribs and interspaces, somewhat smaller on the posterior-dorsal submargins and close to the anterior extremeties; there are about 15 ribs anterior to the umbonal angle and about 6 on the posterior truncation; the larger ribs are rather low, wide and not sharply separated from the bordering interspaces; the summit of the ribs, usually carry a shallow, wide channel or groove, generally ornamented with an elevated thread or a series of coarse beads or ventrally directed small scales or spines; the interspaces usually carry a broad elevated thread and the edge of the ribs are scalloped or cross-striated by evenly spaced incised lines; the ribs or the posterior truncation similarly sculptured; interior concealed.

Length 28mm; height 31mm; diameter 25mm;

Remarks.— This is an elegant species, fairly common in the Saman sandstones of the Chira valley. It is probably a *Trigoniocardia* Dall, a sectional group composed mainly of small species, distinctly Tropical American in their distribution, and heretofore recorded as fossil only from Oligocene and younger rocks.

Locality and Geological Occurrence.— Saman formation, Casa Saman.

Superfamily VENERACEA Menke
Family VENERIDÆ Leach
Genus CLEMENTIA Gray
Subgenus CLEMENTIA s. s.

Clementia (Clementia) peruviana, n. sp. Plate 7, figs. 1, 2, 7

Shell of medium size, inequilateral with the beaks situated at or near the anterior four fifths, the posterior portion of the shell is therefore much longer and the height of the shell being greatest just above the middle; posterior extremity slightly rounded or more obviously truncate; ventral margin well rounded and passing into the relatively short anterior extremity; the convexity of the shell is only moderate and the umbos are therefore not strongly inflated; the posterior dorsal submargins are made slightly concave by a groove-like depression, disappearing anteriorly beneath the beaks; surface sculpture consisting of coarse, concentric, waves, heaviest on the umbonal and early portion of the shell, but gradually become irregular and less heavy towards the ventral margin, finally disappearing or becoming indistinguishable from the growth lines; a finer sculpture of growth lines covers the entire shell; the hinge of the right valve (Saman sandstone specimen) shows a small anterior cardinal tooth, a heavier middle cardinal tooth and a long bifid posterior cardinal; hinge of left valve unknown.

Length 45mm; height 32mm broken; Semidiameter 11mm
(Holotype) Saman Sandstones
40mm; height 38.5mm; Diameter 22mm; Caleto Mero.

Remarks.— *Clementia peruviana* is a common fossil in the Peruvian Tertiaries, beginning in the Restin formation or the upper part of the Middle Eocene, where it is however very rare, and extending through the Upper Eocene and Oligocene rocks. It became extinct sometime during the Upper Oligocene and in the succeeding Miocene, it is replaced by the larger and well-known

Clementia dariena Conrad.

From *C. dariena,* the Peruvian *Clementia* is distinguished by its smaller size, generally less convex and more depressed shell and by its weaker sculpture. In *C. peruviana,* the concentric waves which are strongest and heaviest on the umbonal portion, measure from 2 to 2 1-2 mm. from crest to crest.

Woodring[1] has recently described an Eocene *Clementia* from Colombia, as variety *vetula* of *dariena.* His figures show a more circular shell with nearly central beaks and umbos. It appears to be distinct from the Peruvian shell, an opinion shared by Woodring after comparison of Peruvian specimens with his Colombian shell. Woodring's form is however young, and comes from rocks of the same age as the Peruvian and it is possible that with more material from Colombia will show the shells to be the same or more closely allied.

Localities and Geologic Occurrences.—

Upper Middle Eocene, Restin formation, Negritos (very rare)

Upper Eocene, Saman formation, generally common throughout, Negritos, Talara, Caleto Sal, Casa Saman, Paita, etc.

Lower Oligocene, Chira formation, several localities in the Chira valley, Caleto Sal, etc.

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[1] Woodring, W. P., 1926, American Tertiary Mollusks of the Genus *Clementia* Prof. Paper 147-C, U. S. Geol. Survey, p, 33, pl. 14, figs. 1-4.

Middle Oligocene, Mancora formation, Mancora, Lagunitas, Chira valley, Punta Bravo, etc.

Upper Oligocene, Heath formation, Caleta Mero abundant, Chira valley, etc.

Clementia (Clementia) parinensis, n. sp. Plate 7, figs. 3, 4

Shell small, inequilateral with the beaks quite close to the anterior extremity and with the greatest height of the shell near the middle; posterior extremity subtruncate, the ventral margin evenly rounded and with a relatively short anterior extremity; dorsal margin or slightly arched and apparently grooved near the hinge line; convexity moderate; but varying somewhat in different individuals; no defined lunule; the surface sculpture is Clementoid consisting of strong, concentric waves, regular on the umbos, but gradually disappearing ventrally and becoming indistinguishable from the growth lines; where best developed, the concentric waves or ribs, measure about one millimeter from crest to crest; the whole surface is covered with fine growth lines or threads strongest near the basal margin; interior concealed.

Length 27.5mm; height 22.75mm; diameter 14.5mm;

Remarks.— This is a small but very distinct species, its surface sculptured with typical Clementoid concentric waves and ribs, but varying somewhat in coarseness on different individuals. The posterior extremity is noticeably truncate and the posterior-dorsal submargins grooved or concave. It is a very characteristic species of the Parinas and Restin formation, and thus stratigraphically appears to be the oldest of the true Clementias of the Peruvian section.

Localities and Geologic Occurrences.—

Middle Middle Eocene, Parinas formation, Parinas and Balcones Points, Keswick Hills, Cabo Blanco, etc.

Upper Middle Eocene, Restin formation, Restin, Jabonillal, Negritos.

Clementia (Clementia) restinensis, n. sp. Plate 7, fig. 5, 6

Shell small to medium-sized, inequilateral, ovate-elliptical in form; beaks small and nearly touching, situated quite close to the anterior extremity; the dorsal margin is straight or slightly arched, the ventral margin evenly rounded and passing smoothly into the more acutely, rounded anterior and posterior extremities; there is no defined lunule or escutcheon; surface smooth or sculptured simply with the growth-lines which are somewhat coarser on the anterior and posterior extremeties and towards the basal margin.

Length 42mm; height 35mm; diamete 19.5mm; (type)

Remarks.— The internal characters are concealed. In shape, the shell resembles certain species of *Macrocallista,* but the beaks are more anteriorly situated and there is no lunule or escutcheon. In these features, the fossil resembles closely *Clementia* and probably belongs to that genus. They differ from most species of *Clementia,* in lacking the concentric, characteristic Clementoid waves or ribs and the surface of the shell is nearly smooth.

Localities and Geologic Occurrences.— Restin formation, Pozo valley near Lagunitas, Restin.

Genus GRATELOUPIA Desmoulins

Subgenus GRATELOUPIA s. s.

Grateloupia (Grateloupia) peruviana, n. sp. Plate 8, figs. 2, 5

Shell small or medium size, nearly equilateral; in form the shell is Mulinoid or that of a small *Iphigenia;* moderately convex, greatest about the center of the shell, midway between the nearly equal and similar anterior and posterior extremities; ventral margin widely rounded or curved and slightly flexed in the posterior-ventral region; dorsal margin straight or nearly so, sloping to form a bluntly pointed, posterior extremity and a more rounded anterior extremity; beaks very small, inconspicuous and closely adjacent; lunular area depressed, narrowly lanceolate and defined from the rest of the shell by a deeply impressed line; surface smooth or only faintly marked by the growth lines; hinge of right valve show two strong cardinals followed posteriorly by a wide nymphal area which includes the fused third cardinal; other internal characters concealed in the matrix.

Length 26mm; height 19.5mm; semidiameter 6.50mm;

Remarks.— Although this is a common species in the Parinas sandstone, the internal characters are difficult to determine, as the shells are most generally found enclosed in a hard sandy matrix. A single right valve collected, shows two evident cardinal teeth, followed on the posterior side by a wide nymphal area which probably includes the fused third cardinal. In this character, the hinge agrees with *Grateloupia*, typified in the Mulinoid or *Iphigenia*-like shape. The true *Grateloupia*, typified by *Donax irregulari* Basterot (*Grateloupia doniciformis* Desm.) have previously been recorded only from the European Miocene where they are found in the Aquitanian and Vienna basins and in the Italian Piedmont.

Localities and Geologic Occurrences.— Parinas formation, Parinas and Balcones Points.

Genus MACROCALLISTA Meek

Macrocallista inca, n. sp. Plate 8, figs. 1, 4

Shell of medium size, elongate or elliptical in shape, the greatest height of the shell being about midway between the anterior and posterior extremities; beaks rather small and near the anterior one-fifth and one-sixth; convexity of the shell is moderate, greatest in the dorsal umbonal region, and below which the shell is slightly impressed along a band extending from the beaks towards the posterior ventral margin; basal and dorsal margins well rounded, anterior extremity slightly produced, bounded above by the straight or slightly curved lunular margin; the exterior of the shell is smooth or porcellaneous, marked simply by fine growth lines; internal characters concealed.

Height 41mm; length 64mm; diameter 26mm;
33mm; length 52mm; diameter 17mm;

Locality and Occurrence.— Saman formation, Saman sandstones of Casa Saman, Chira Valley.

Genus PITARIA Rœmer

Subgenus PITARIA Rœmer

Section PITARIA s. s.

Pitaria (Pitaria) sciæna, n. sp. Plate 7, figs. 8, 9

Shell small to medium size, porcellaneous, subequilateral, with high and nearly central umbos; anterior and posterior extremities nearly equally rounded or the posterior slightly more pointed; the shell is moderately convex, with wide, full umbos and with small, scarcely prosogyrate beaks; lunule elongate-lanceolate and defined by a fine, impressed line; escutcheon not differentiated; the surface is smooth or marked only with growth lines, strongest on the older shell and along the posterior dorsal slope.

Length 34mm; height 27mm; semidiameter 9mm;

Remarks.— A fairly common species in the Pale Gredas of Restin. It differs from *M. bosworthii* and *negritosensis* Woods by its much smaller size.

Locality and Geologic Occurrence.— Pale Greda formation, Restin.

Subgenus HYSTEROCONCHA Fischer

Section LAMELLICONCHA Dall

Pitaria (Lamelliconcha) negritensis, n. sp. Plate 8, fig. 3

Shell small to medium size, ovate-eliptical; beaks near the anterior one-third and with the greatest height of the shell in this region, the dorsal margin is slightly arched or straight, descending towards the posterior extremity which appears obliquely subtruncate; the anterior extremity appears somewhat produced with a straight lunular margin and a rounded basal margin; lunule narrowly lanceolate; sculpture consists of concentric bands developed on the umbos, the anterior submargins and the posterior-dorsal slopes but they are lacking from the center of the shell-disk, where the surface is smooth and polished; on the anterior submargins and the umbonal slopes, the concentric bands become rounded ridges, with deep, narrow interspaces; hinge of left valve shows three cardinal teeth and one anterior lateral; pallial sinus not evident in our specimens; ventral margin smooth.

Length 36.5mm; height 24mm; diameter 12.5mm;

Remarks.— The type specimen is somewhat crushed so that the posterior extremity appears to be more pointed than it actually is in nature. The shell has the general features of *Macrocallista* and probably should be referred to that genus, rather than *Pitaria.* It is distinguished from allied species by its sculpture, which is obsolete from the center of the shell disk. The *M. Dickersoni* Wood is quite common in the Clavilithes beds. It differs by its smoothly elliptical and convex form and even regular concentric sculpture.

Locality and Geological Occurrence.— Negritos formation, Negritos.

Pitaria (Lamelliconcha) parinensis, n. sp. Plate 8, figs. 6, 8

Shell small, ovate-elliptical, inequilateral and with the beaks near the anterior one-third; convexity of shell moderate or slight basal margin rounded or slightly flexed or emarginated posteriorly; posterior dorsal margin straight and with a bluntly pointed anterior and posterior extremity; lunule small, lanceolate and deeply sunken; surface sculpture of fine, regular, narrow ribs or ridges, spaced about three-fifths of a millimeter apart on the shell disc; they number about 35 on the type specimen; interspaces very wide and marked by 2, 3 or more coarse growth lines; interior concealed by the matrix.

Length 24mm; height 16.5mm; semidiameter 5mm;

Remarks.— This is a small species quite common in the Parinas sandstones. From the *P. saponaria* of the Restin formation, this species is recognised by its smaller size, finer sculpture and flexing of its posterior ventral margin.

Localities and Geological Occurrence.— Parinas formation, Keswick, Hills and Balcones Point.

Pitaria (Lamelliconcha) saponaria, n. sp. Plate 8, fig. 11

Shell small, ovate-elliptical, inequilateral, moderately convex, and with the beaks situated near the anterior one-third; lunule small, lanceolate; basal margin broadly curved, passing into the bluntly pointed posterior extremity; surface sculptured with even, narrow, concentric ribs or ridges, rounded on top; the concentic ribs number about 34 on the type specimen and are spaced about three-fourths mm. apart on the center of the shell disc, and separated by deep, flat interspaces, nearly twice as wide; the ribs and interspaces are finely marked by the concentric growth lines interior largely concealed in the type specimen, a fragment of the left valve shows a strong lateral tooth and three cardinals.

Length 27mm; height 18mm; semidiameter 6mm;

Remarks.— A rare species represented in our collection by the type and two fragmentary specimens. It is recognized by its even and rather coarse concentric sculpture.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Pitaria (Lamelliconcha) salsola, n. sp. Plate 8, fig. 7

Shell of moderate size, elliptical, inequilateral, with the beaks near the anterior third; convexity of shell slight; basal margin well rounded on the anterior half, becoming slightly rounded or nearly straight on the posterior half and slightly flexed just in front of the posterior dorsal umbonal slope; dorsal margin is straight or nearly so, with the posterior extremity slightly rounded or subtruncate; the anterior extremity appears somewhat produced and bounded above by the concave lunular margin; surface of shell is marked with a close sculpture of concentric ribs or bands, generally evenly spaced, but sometimes becoming crowded and marking resting stages in the development of the shell; these bands are separated simply by incised or impressed lines; hinge characters concealed, but molds of the interior show a large, pallial sinus, extending to and slightly behind the middle of the shell.

Length 33mm; height 20mm; semidiameter 5mm;

Remarks.— Recognized by its elongate form, slight flexing of its posterior-ventral margin and its close-set sculpture of concentric bands, divided simply by incised lines. It belongs in the horizon of the Saman conglomerate.

Locality and Geologic Occurrence.— Saman formation, Salina, near Negritos.

Pitaria (Lamelliconcha) samanensis, n. sp. Plate 8, fig. 9

Shell of moderate size, ovate, inequilateral with the beaks about the anterior third; convexity very slight and the shell appearing nearly depressed; basal margin slightly rounded, a pointed posterior extremity and a well rounded anterior extremity; dorsal margin slightly convex or arched midway between the beaks and the posterior extremity; surface sculpture of regular, and rather coarse, concentric ribs or ridges, seemingly reflexed or inclined dorsally; the ribs are spaced nearly a millimeter apart on the shell disk and number about 40 or more on an average specimen; interior concealed.

Length 36mm; height 26mm; diameter 12mm;

Remarks.— A fairly common species in the Upper Saman rocks but good specimens have not been obtained. It differs from the previously described species by its more pointed, shorter and ovate shaped shell.

Locality and Geologic Occurrance.— Saman formation, Casa Saman.

Section TIVELINA Cossmann

Pitaria (Tivelina) siliqua, n. sp. Plate 8, figs. 12-14

Shell small, inequilateral and moderately heavy; shape subtrigonal, with the beaks near the anterior fourth, small, pointed, adjacent and slightly curved anteriorly; basal margin broadly rounded passing into a pointed or bluntly rounded posterior extremity; the valves are slightly flexed along a line just anterior to the posterior dorsal slope; anterior extremity short and narrowly rounded and passing into the lunular margin which is straight; convexity moderate; lunular area broadly elliptical; surface somewhat rough and sculptured simply by the growth lines, heavier along the posterior-dorsal slope and towards the margin; interior concealed.

Length 20mm; hieght 16.5mm; diameter 11.5mm;

Remarks.— This is a small species distinguished by its pointed posterior extremity and general Nuculoid form. Its posterior portion is slightly flexed and the surface is marked with fairly coarse irregular growth lines. It probably belongs to *Tivelina,* Cossmann considered by Dall as a section of *Pitaria.*

Locality and Geologic Occurrence.— Negritos formation, Negritos.

Genus CALLOCARDIA A. Adams

Callocardia salvia, n. sp. Plate 8, fig. 10

Shell small or of moderate size; cordate, inflated, inequilateral, with beaks near the anterior fourth; umbos wide and full with fairly prominent and slightly prosogyrate beaks; lunule elliptical and on our specimens defined by a feeble impressed line; the basal margin is evenly rounded, passing into a broadly rounded or subtruncate posterior extremity, on one side and a somewhat pointed anterior extremity on the other; the exterior is sculptured simply by crowded growth lines and the surface of the shell is slightly rough to the touch; hinge of the right valve shows a socket for the left lateral and three cardinal teeth, the middle one bifid; the posterior-dorsal margin grooved.

Length 33mm; height 26.5mm; diameter 19mm;

Remarks.— This species resembles somewhat the *Pitaria osiæna,* but differs by its more inequilateral shell and by its more curved beaks. The type specimens are from the top of the

Salina formation, but the species continues into the Parinas sandstones.

In the lower Saman shales near Negritos, there are small shells scarcely distinguishable from the typical *C. salvia.* Judging by our collection, these shells are smaller, and somewhat longer, characters are recognized of very minor value. Since they occur at a much higher horizon, these characters may be of greater importance than they would seem at first, and for this reason, this form may be separated as variety *gemma.*

Superfamily TELLINACEA Blainville

Family TELLINIDÆ Deshayes

Genus MACOMA Leach

Subgenus PSAMMACOMA Dall

Macoma (Psammacoma) talarensis, n. sp. **Plate 9, fig. 6**

Shell thin, elongate-ovate, moderately convex, equivalve, with an outline suggestive of *Periploma,* anterior side rather long, wide, the posterior side shorter and contracted to about one-half the height of the anterior and less than one-half as long; umbos wide but not prominent with small beaks, situated about the anterior 2/3rds; the ventral margin is evenly rounded; the anterior-dorsal margin straight, the posterior-dorsal margin strongly descending and concave upward; the anterior extremity is broadly rounded, the posterior subtruncate; the posterior side is weakly flexed by two subobsolete folds, one lying along the umbonal slope, paralleled posteriorly by a faint sinus and this in turn by a second faint fold; shell very thin, with a nearly smooth surface.

Length 24mm; height 15mm; semidiameter 3.5mm;

Remarks.— The internal characters are concealed and the reference of the shell to *Macoma* is based on external resemblance. The shell is extremely thin and in form resembles certain species of *Periploma.* The *Tellina formosa* Philippi from Lebu Chile is very similar in general form to the Talara shell, but is larger (55 mm.), higher and with the ventral margin more strongly rounded.

Locality and Geologic Occurrence.— Saman formation, Talara.

Family DONACIDÆ Deshayes

Genus DONAX Linné

Subgenus DONAX s. s.

Donax (Donax) parinensis, n. sp. Plate 9, fig. 3

Shell of the usual size for the species of the genus, elongate-subtrigonal, solid, a strong posterior truncation and a fairly heavy radial sculpture; posterior extremity very short, sharply truncate so that the plane of its surface is almost perpendicular with that of the adjacent surface of the shell; anterior end much longer, cuneate and with the extremity narrowly rounded; ventral margin evenly rounded but somewhat arched or vaulted in the middle by a broad fold extending from the beak and over the umbonal region; anterior-dorsal margin straight; anterior-dorsal submargin excavated and smooth; the shell is moderately convex with a broad fold extending ventrally across the umbo, and bordered on each side by a depressed band; surface sculpture consists of rather strong, radial ribs, sometimes crenulated by concentric lines; the radial ribs are very fine on the posterior truncation, while on the general surface of the shell, they are flat and low over most of the anterior portion, but become strong and rounded in contour from about the center and across the depressed band to the posterior-umbonal angle; on the anterior portion, the flat ribs may be finely crenulated by incised concentric lines; internal margin sharply crenulated.

Length 21mm; height 15mm; semidiameter 5.75mm;

Remarks.— This is a true *Donax*, with a strongly truncated posterior side, rather heavy sculpture of radial ribs and a serrated or crenulated margin. The single type specimen was collected in the Parinas sandstones of Keswick Hills three or four miles east of Negritos.

Locality and Geologic Occurrence.— Parinas formation, Keswick Hills.

Section LATONA Schumacher

Donax (Latona) prosopsis n. sp. Plate 9, fig. 2

Shell elongate or donaciform, thick, the anterior side long, the posterior side much shorter and about 1/3rd the length of the whole shell; the shell is slightly convex, the greatest inflation being along the umbonal ridge a short distance in front and below the beak; ventral and dorsal margins straight but not quite parallel; the anterior extremity is straight or subtruncate, meeting the ventral margin at slightly less than 90 degrees; the posterior portion of the shell is strongly depressed or flattened and with a strong umbonal angle, extending from the beak to the posterior-ventral margin; the surface of the shell is smooth or slightly roughened by irregular growth lines, heaviest on the anterior portion; there are faint indications of radiating lines or striæ on the posterior portion of the shell; the hinge margin appears to have been smooth.

Length 31.5mm; height 17mm; semidiameter 5.5mm;

Remarks.— This species is provisionally referred to the Section *Latona* Schumacher, but in most of the recent species of this group, the umbonal angle is less prominent, and the posterior slope is generally quite strongly sculptured with radial striæ.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Donax (Latona) capparis, n. sp. Plate 9, fig. 7

Shell donàciform, elongate-subtrigonal, with a strong, posterior truncation, and a longer anterior end; beaks small, situated about the anterior 2/3rds; ventral margin evenly rounded; the anterior-dorsal margin is straight and descending, meeting with the ventral margin to form a narrowly rounded anterior extremity; the posterior side is straight, meeting the ventral margin at an angle of less than 90 degrees; umbonal slope is angled but not carinate; surface smooth; the ventral margin was probably smooth.

Length 33mm; height 21.5mm; diameter 11mm;

Remarks.— From the preceding species, to which this shell is obviously related, it will be distinguished by its more typical *Donax*-like form and more trigonal outlines. Its surface is plain and smooth. The ventral margin appears to have been smooth.

Locality and Geologic Occurrence.— Salina formation, Negritos.

Superfamily MACTRACEA Gray

Family MACTRIDÆ Gray

Genus SPISULA Gray

Subgenus SPISULA s. s.

Spisula (Spisula) caleta, n. sp. Plate 10, fig. 1

Shell of moderate size, very thin, nearly equilateral, moderately inflated, smooth; form as figured is broadly subtriangular with a smoothly rounded ventral margin, and with the dorsal margin straight on the posterior side but concave on the anterior; umbos prominent central, with conspicuous and closely adjacent beaks; the posterior-dorsal submargins is generally a little convex towards the posterior side but becoming concave nearer the beaks and generally carrying two or more obscure, radiating folds or ribs, one of which forms the rounded, umbonal angle; anterior-dorsal margins concave and deep; surface smooth or simply sculptured by the growth lines; interior concealed.

Height 48mm; length 57mm; semidiameter 25.5mm;

Remarks.— The hinge of this fine species is not preserved in our specimens, but the general form of the shell is that of a typical *Spisula* and may be paralleled by any number of species in the recent and Tertiary faunas. The texture of the shell is extremely thin and in most of the fossils, it is preserved in thin tissue paper-like patches or when weathered as a soft chalky covering.

The *S. decisa* Conrad from the Claibornian of Alabama and Louisiana is similar to the present species, but is proportionately longer and heavier.

Locality and Geologic Occurrence.— Saman formation, Caleta Sal.

Spisula summa n. sp. **Plate 10, figs. 5, 6**

Shell of medium size, subtriangular, convex and nearly equilateral; umbos wide but not very prominent, and with the beaks situated a little anterior of the middle; umbonal slope angled but not sharply, and with the posterior-dorsal submargins rather wide, and slightly vaulted or convex; the anterior submargin is wide and slightly concave; ventral margin evenly but not strongly rounded, with the anterior extremity narrowly rounded and the posterior subtruncate; surface is smooth or marked only by the growth lines but with the anterior-dorsal submargins more finely sculptured with even, regular lines; hinge imperfectly preserved in our specimens, shows two strong laterals, a V shaped cardinal and a resilium pit.

Length 44mm. broken; height 44mm.; semi-diameter 17mm. holotype
49mm.; height 42mm.; semi-diameter 15mm.

Remarks.— The type specimens come from the Pale Gredas of Restin and their average size is about 44mm. in height. They are similar in general characters to specimens in our collection from the Salina formation near Negritos, with exception that the umbos are somewhat higher and wider. What is likely the same species or a closely allied form occurs in the Restin formation at Jabonillal, where the largest specimens reach a height of about 58mm.

From the *S. caleta,* this species is distinguished by its heavier shell, its wide but less prominent umbos and general Mulinoid form.

Localities and Geologic Occurrence.— Salinas formation, Negritos. Pale Greda formation, Restin. Restin formation, Jabonillal.

Spisula (Spisula) hualtaca n. sp. **Plate 9, fig. 4**

Shell elongate-subovate, nearly equilateral, depressed or but little convex; form as figured, with the height approximately three-fifths of the length, the umbos low and depressed and with small, erect pointed beaks, situated about the middle of the shell; anterior and posterior sides subequal, that of the anterior side slightly the longer and with the dorsal margin somewhat contracted; ventral margin is broadly rounded, the dorsal-posterior margin vaulted or nearly straight; the posterior extremity is rounded that of the anterior extremity more narrowly rounded; shell was probably very thin in texture.

Length 44mm.; height 26mm.; semi-diameter 4.5mm.

Remarks.— The species is based on a single internal cast ot the right valve from the Saman shales of Caleta Sal. It differs from the other Peruvian Mactroids, in its more elongate form and strongly depressed shell. The beaks are low, nearly central, and the umbos flat and depressed. The texture of the shell was probably thin and smooth, without any indication of concentric plicæ such as occur on the ventral portion of the shell in *Spisula callistoides* and *deserta.* The pallial sinus is faintly indicated on the specimen. It appears to have been of moderate size, open, wide and reaching not quite to the center of the shell.

Locality and Geologic Occurrence.— Saman formation, Caleta Sal.

Subgenus HEMIMACTRA Swainson

Section OXYPERAS Morch

The section *Oxyperas*[12] with *S. ariangularis* Lam. as its type species, is chiefly of Indo-Pacific distribution. The shells are typically triangular in shape and the surface of the valves is ornamented with strong, concentric plicæ. This section is well represented in the Peruvian Tertiaries by several typical species.

Spisula (Oxyperas) callistoides n. sp. Plate 10, figs. 3, 4

Shell of medium size, nearly equilateral convex; the form as figured is broadly subtriangular, with the height about two-thirds that of the length; ventral margin is slightly rounded with a bluntly pointed posterior extremity and a narrowly rounded anterior extremity; the dorsal margins are straight and bordered on each side of the beaks by wide, flat submargins; the umbonal slope is angled or with a low fold, below which the shell carries a faint concave band or sinus towards the ventral margin; the umbos are wide and prominent. with conspicuous beaks; surface of shell appears to be generally smooth on the umbos but becoming strongly plicate or sculptured with regular concentric ribs towards the basal margin or covering an area approximately the lower one-third; these concentric ribs number generally between 8 to 10 and are sufficiently heavy to extend through the shell and to be impressed upon the internal moulds; the posterior dorsal submargins are smooth, while the anterior-dorsal submargins are sculptured over the whole area by fine, regular, concentric threads or fine ridges; interior concealed.

Length 54mm.; height 34.5mm.; diameter 28mm.

Remarks.— This species is fairly abundant in the Saman sandstones of the Chira Valley. In form and general characters, it approaches closely the *S. triangularis* Lamarck, a recent species and the type of *Oxyperas.* There are 3 or 4 recent species of *Oxyperas,* distributed mainly in the western Pacific region, from New Zealand north to Japan.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Spisula (Oxyperas) deserta n. sp. Plate 10, figs. 2, 7

Shell small, nearly equilateral, moderately convex; shape is broadly triangular or hatchet-shaped, the height somewhat less than the length, and with the beaks and umbos more or less centrally placed; ventral margin smoothly rounded with straight dorsal margins, descending from the beak to form the nearly equally rounded anterior and posterior extremities; the umbonal slope is rounded or with a faint fold and bordered on the hinge side by wide and slightly convex submargins; surface is smooth on the umbos but becoming plicate or sculptured with regular and fairly coarse, concentric ribs on the ventral one-third; the concentric ribs number 8 to 10, are rounded and separated by deep grooves, and become replaced on the anterior submargins by finer ribs; a faint sinus parallels the umbonal angle and extends from the beak to the posterior ventral margins; interior concealed.

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[12] See Ed Lamy, 1917, Revision de Mactridæ Vivants, Journ de Conchyl. vol. 63, p. 323, pl. 7, fig. 1.

Length 28.5mm.; height 27.5mm.; semi-diameter 8mm.

Remarks.— From *S. callistoides,* this species differs by its smaller size, higher shell and somewhat finer sculpture. It occurs in a hard ferruginous sandstone layer, associated with *Spisula caleta, Amotapus arbolensis,* etc., in the Saman shales of Caleta Sal.

Locality and Geologic Occurrence.— Saman formation, Caleta Sal.

Spisula (Oxyperas) parinensis n. sp. **Plate 9, fig. 5**

Shell small, convex or moderately inflated, subtriangular; umbos high and prominent with pointed, conspicuous and central beaks; ventral margin slightly rounded and usually indented or flexed towards the posterior extremity; the umbonal slope is weakly angled and bordered on the hinge side by the slightly convex and vaulted submargins; the anterior dorsal submargin is concave or excavated greatest immediately in front of the beak; the anterior extremity is somewhat produced and narrowly rounded, the posterior more broadly rounded; surface of shell is smooth on the umbonal portion, but towards the basal or ventral margin becoming sculptured with fine, regular, incised lines; on the hinge side of the anterior-dorsal submargins, the surface is often sculptured with heavy concentric ribs, divided by deeper incised lines; hinge concealed.

Length 16.5mm.; height 11.5mm.; semi-diameter 4mm.

Remarks.— This is a small species locally common in the Parinas sandstones and the Saman conglomerate, the average length of specimens collected being about 15mm. At first it might be suspected to be the young of *S. deserta* of Caleta Sal, but differs by its constant smaller size and more produced anterior extremity. Its sculpture is also finer.

Localities and Geologic Occurrence.— Parinas formation, Balcones Point. Saman formation, Salina, near Negritos.

Superfamily MYACEA Menke

Family CORBULIDÆ Fleming

Genus CORBULA Lamarck

The genus *Corbula* is represented in the Peruvian Tertiaries by numerous species. Four species were described by Woods from Eocene rocks, namely the C. *arnoldi, waringi, peruviana* and *parinasensis,* the three former from the *Turritella series* or restricted Negritos formation, and the last species from the Parinas sandstones. The *C. parinasensis* is a large, fairly smooth and nearly equivalved form, which becomes more common and larger in the Restin formation. Several additional species are described in this paper, but others are represented in our collection, but too imperfectly preserved for description.

There is some confusion amongst authorities as to the type species to be selected for the genus *Corbula.* In 1847, Gray selected the *C. sulcata* Lamarck, as the type species, and most European authors and others have followed this usage. Dall however points out that this species was earlier used as the sole example of Muhlfeldt for *Aloidis* and must be retained for the section of the genus typified by that species. Dall therefore selected as the type species, the *C. gallica* Lamarck a species used by Fischer as the type for his section *Bicorbula.*

In Dall's classification of the *Corbulidæ,* most of the Peruvian species would belong in the Section *Cuneocorbula* of Cossmann, but the type *C. biangulata* Deshayes of the Parisien Eocene is bicarinate and quite different from the American shells usually placed in that section.

The Restin species, described here as *C. bursera,* differs widely from any described Corbulas of which we have found record. The hinge is unknown but its external characters are so peculiar that a new section *Cuspicorbula,* named for its likeness to *Cuspidaria,* is proposed for its reception.

Section CORBULA sensu lato

Corbula negritensis n. sp. Plate 11, figs. 3, 4

Shell of medium size, solid, nearly equilateral and equivalve; form as figured is broadly elongate, the posterior extremity is rostrate and slightly longer; umbos wide but not prominent, with small inconspicuous beaks; posterior end subtruncate, with a strong angle or keel on the rostrum; both valves similarly sculptured with strong, concentric ribs, nearly equal on the lower half of the shell, smaller and fainter on the umbos; the ribs number 12 or more subtriangular in section and the interspaces V shaped, the rostral area is smooth or sculptured with irregular growth lines; there is a finer, submicroscopic sculpture of radial threads in lines, covering the ribs and interspaces alike; interior concealed.

Length 11mm.; height 8mm.; diameter 5.5mm.

Remarks.— The *Corbula aulacophora* Morelet, from the Bartonian French Eocene is similarly sculptured but more inequilateral and pointed posteriorly. The species also resembles the *C. sphenia* Dall from the Chipola Miocene but is only half as large.

Locality and Geologic Occurrence.— Negritos formation, Negritos.

Corbula boggsi n. sp. Plate 11, figs. 18–20

Shell small, solid, inflated, with nearly central beaks and umbos, and similar sculpture on both valves; the right valve is nearly equilateral and somewhat larger than the left, its posterior side carrying a short rostral carina and a slight emargination or fold along the ventral margin; the left valve is inequilateral oblique with a short posterior end, provided with a rostral angle and truncated at its extremity; the anterior end is wide, with sloping dorsal margin and rounded extremity; ventral margin flattened or contracted; sculpture consists of 12 or more, subregular, concentric ribs or waves, absent from the umbos which are smooth; the rostral area is smooth; interior concealed.

Length 8mm.; height 6mm.; diameter 5.5mm.

A smaller and shorter species than the preceding, recognized by its oblique shell and fine sculpture. It is abundant in the horizon of the Saman conglomerate.

Locality and Geologic Occurrence.— Saman formation, Negritos.

Corbula salina n. sp. Plate 11, fig. 15

Shell small, irregular, strongly twisted or rostrate behind and strongly sculptured with few, coarse, concentric ribs; right valve sub-equilateral with nearly central beaks and wide umbos, a rounded anterior end and a shorter, rostrate or pointed posterior end; the right valve is slightly larger than the left, and with the posterior portion of the ventral margin, widely overlapping the left valve; the left valve is inequilateral, oblique, with the anterior end very long and wide, and with a short, angled posterior end; the rostral area is produced, somewhat twisted, concave above; the ventral margin is rounded that of the right valve widely embracing the left along the posterior side; sculpture consists of 12 or 13, regular but somewhat wavy, concentric ribs, strongly developed over the whole surface and they may continue across the rostral area of the right valve; interior concealed.

Length 7.5mm.; height 4.5mm.; diameter 3.5mm.

Remarks.— This is a small and common species in the Saman conglomerate and may be recognized by its coarse, heavy sculpture.

Locality and Geologic Occurrence.— Saman formation, Negritos.

Corbula greda n. sp. Plate 11, figs. 13, 14

Shell, small, convex, elongate-ovate, widest about the anterior portion, rostrate behind and delicately sculptured; right valve inequilateral but with nearly central beaks and most strongly convex about the anterior one-fourth; the posterior side is shorter, rostrate, obliquely truncated but pointed and twisted at its extremity; left valve is similar but smaller and slightly embraced by the right valve, along the posterior ventral margin; posterior portion of each valve with a rostral angle or keel, strongest towards the extremities; the surface is sculptured with fine regular concentric threads or small ribs, similar on both valves; interior concealed.

Length 6.5mm.; height 4mm.; diameter 3.5mm.

Remarks.— A small delicately sculptured species common in the Upper Restin shales and sandstones at Jabonillal where it occurs associated with *Corbula parinasensis* and *jabonillænsis.* It is the smallest species known from the Peruvian Tertiaries, the largest specimens in our collection, measuring about 6 1-2mm.

Locality and Geologic Occurrence.— Restin formation, Jabonillal

Corbula jabonillænsis n. sp. Plate 11, figs. 11, 12

Shell of medium size, thin, equivalve, elongate-ovate, convex, strongly keeled; valves nearly similar in shape and sculpture, the right valve slightly the larger; beaks slightly posterior to the middle and with the greatest convexity about the center and with a faint sinus or depressed band extending from the beaks to the ventral margin; ventral and dorsal margins straight and nearly parallel with a well-rounded anterior end and a pointed and strongly keeled posterior end; the rostral angle is sharply keeled, bordered above by a concave rostral area on each valve; the sculpture consists of fine, sharp, regular, concentric threads, similar over the whole shell; interior concealed.

Length 12mm.; height 7.75mm.; diameter 4.5mm.

This is a rare species from the Upper Restin of Jabonillal. It is closely paralled in the recent fauna by *C.* probably *bicarinata* Sby of the Peruvian coast, the two species being similarly sculptured and with the rostral angle sharply keeled. In the recent species, there is a second keel bordering the hinge margin and enclosing a smooth, elongate, escutcheon-like area along the hinge margin. In the Jabonillal shell, this part of the valve has been destroyed by weathering.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Corbula tangara n. sp. Plate 11, figs. 9, 10

Shell of medium size, solid, strongly inflated with a pointed and somewhat twisted posterior end; both valves nearly equal in size and strongly convex, the right valve developing a depressed band or broad sinus towards the posterior ventral margin, which more or less overlaps the ventral margin of the left valve; umbos very wide, with very small, central and inconspicuous beaks; anterior end is broadly rounded and convex, with the dorsal and ventral margins sloping to form the pointed and somewhat twisted, and rostrate posterior end; the rostral angle is generally weak, except towards the extreme posterior end; surface sculptured similarly on both valves with 35 or more, fine, regular, concentric ribs, which are generally lacking on the umbos; the sculpture of the left valve is usually a little weaker and the ventral portion of the shell may be nearly smooth; on the right valve, the sculpture parellels the curve of the ventral margin; no lunule; interior concealed.

Length 14mm.; height 9.5mm.; diameter 10.25mm.

This is a common species in the Saman rocks, recognized by its very tumid or inflated shell. Both valves are sculptured similarly with fine, concentric ribs which follow the contour of the ventral margin of the valves.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Section CUSPICORBULA n. sec.

The following is a description of the Section *Cuspicorbula* type *C. busera* n. sp.

Shell ovate, solid, both valves strongly and nearly equally convex; the posterior end is abruptly contracted or constricted by a deep sinus, extending from the umbonal region, across the ventral or basal margin; lunular area deep; sculpture consists of strong, concentric ribs on the right valve, less heavy on the left; hinge unknown.

Corbula (Cuspicorbula) busera n. sp. Plate 11, figs. 5-8

Shell small or medium-sized, solid, inflated, coarsely sculptured and with the posterior extremity strongly contracted and rostrate; the anterior and central portion of the valves is strongly convex or inflated, oblique, with a deep, wide, cordate lunular area in front and below the beaks; the posterior end is strongly contracted into a short, rostrate portion by a deep sinus, directed towards the left from the central and anterior part of the shell, and the general form of the shell is suggestive of a *Cuspidaria*; the right valve is slightly larger than the left and less strongly sculptured; sculpture of the right valve consists of about 10 or 12 coarse, concentric ribs, separated by wide interspaces, and these ribs are continued across the posterior sinus to the posterior extremity; on the umbos, this sculpture is generally much finer; the sculpture of the left valve is similar to the right but finer; interior concealed.

Length 13mm.; height 9.5mm.; diameter 9.25mm.

Locality and Geologic Occurrence.— Restin formation, Restin.

Class GASTROPODA

Subclass STREPTONEURA

Order CTENOBRANCHIATA Schweigger

Superfamily PTENOGLOSSA Gray

Family EPITONIIDÆ Dall

Genus EPITONIUM Bolten

Subgenus ACRILLA

Epitonium (Acrilla) peruvianum n. sp. **Plate 12, figs. 10-12**

Shell small, very slender and with numerous slowly tapering whorls; the whorls are strongly convex and firmly united by close sutures; varices are delicate, narrow, porcellaneous and smooth, oblique to the general axis of the shell and inclined down towards the right; the varices number about 18 on an average size whorl, have no regular arrangement with respect to the adjacent whorls, and only through coincidence on certain specimens, do they appear continuous across the sutures or from whorl to whorl; the intervarical spaces are much wider, excavated or concave and usually darker in color than the varices themselves; the intervarical spaces are finely sculptured with fine, sub-microscopic spiral striæ; a thin basal disc is present, crossed by the varices to the umbilical region, and also sculptured by the spiral striæ; mouth circular, with a thin or weak lip and a probably discontinuous peristome; umbilicus closed.

Length 14mm.; diameter 4.5mm.; (5 1-2 whorls)

Remarks.— All our specimens of this species are fragmentary, lacking the apical and apertural whorls. The shell is very long or slender, with numerous, slowly tapering whorls. It is finely sculptured with narrow, smooth and rounded varices and the interspaces with fine, microscopic spiral striæ. In exceptional well-preserved specimens, the intervarical spaces may also show fine, longitudinal lines, so that the resulting sculpture appears minutely trellised or shagreened. A thin, basal disc is present, similarly sculptured with varices and fine spiral striæ.

This species is very characteristic of the horizon of the Saman conglomerate, and although always fragmentary, it is recognized by its delicate and beautiful sculpture. Our collection contains fragments of a second species, similar in most respects to *E. peruvianum*, but with much heavier spiral striæ.

Localities and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate, south of Negritos, Pozo.

Family SOLARIIDÆ Chenu

Genus ARCHITECTONICA Bolten

Architectonica sullana n. sp. Plate 12, figs. 1, 2

Shell rather large for the species of the genus, moderately elevated and deeply umbilicate; whorls about 6 in number, each slightly convex in profile; young shells are generally depressed but with growth become proportionately higher and the spire angle steeper; periphery of the whorl is strongly carinated by a heavy, smooth, spiral cord, which is bordered on the upper surface by a second, smooth cord, the two usually following closely, the course of the sutures on the earlier whorls (this is a variable character and some shells, have only a single sutural carina or none at all); on the lower surface, the peripheral cord is bordered by a smaller, smooth cord and an intervening deep, spiral groove; with exception of the above spiral sculpture, the surface of the shell is smooth except for the growth lines; the umbilicus is wide, scalar and deep, the umbical angle is strongly nodulated with about 26, strong teeth; the umbilical wall of each whorl is straight, with a single, strong, smooth, spiral rib.

Height 24.5mm.; diameter 43mm.

Remarks.— This is a large species for the genus, the type specimen selected coming from the Saman sandstones of the Chira Valley and has a diameter of about 43 mm. It appears for the first time in the Saman formation, and continues into the overlying Oligocene, as high as the lower part of the Heath formation. The shells are generally large but usually badly broken. In the Restin, the larger specimens of *A. nelsoni* may resemble the present species, and it is evident on closer study that *A. nelsoni* was probably the percursor of *A. sullana.* Continued evolution has resulted in the development of nearly smooth whorls, a nodulated umbilical angle and a ridge or rib on the umbilical wall.

The surface of the whorls appear generally smooth, but on the better preserved parts of the shell, a faint indication of spiral lines may usually be seen. The periphery is strongly carnated in young shells, but in older individuals the peripheral cords may become subobsolete, and the peripheral edge of the whorls, more or less excavated and overhanging.

Localities and Geologic Occurrence.— Saman formation, common throughout, but especially at Casa Saman and Paita; Oligocene records will be given later.

Architectonica jabonillensis n. sp. Plate 12, figs. 6, 9

Shell small or medium sized, moderately elevated, and with a rounded periphery; whorls about 6, generally flat or slightly excavated; nucleus small, sinistral and immersed in the succeeding whorls; the periphery of the whorls is rounded and with the adjacent upper surface generally slightly excavated; upper surface of whorls sculptured with beaded spiral threads or cords which are strongest just in front of the sutures; the suture is bordered in front or below by a wide but not strong, beaded, spiral cord, and this in turn by 3, weaker beaded spirals, gradually diminishing in size, in a direction away from the suture; the surface of the whorl above the suture is usually excavated and ornamented simply by very fine spirals, either smooth or faintly beaded, and a small cord generally borders the suture on the posterior side; the lower surface of the last whorl is sculptured, much like the anterior portion of the upper surface, with simple spiral threads, increasing in size towards the umbilicus; the umbilicus is wide and deep, the umbilical angle strongly or subobsoletely modulated and the umbilical wall sculptured with simple spirals, two of which are slightly larger than the others, and which may represent the umbilical rib.

Greater diameter 19mm.; height 10mm.

Remarks.— This species is fairly abundant in the Upper Restin sandstones and shales of Jabonillal, associated with *A.*

nelsoni Woods. From *A. chiræensis*, this species differs by its more rounded periphery and finer sculpture.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Architectonica chiræensis n. sp. Plate 12 figs. 13, 14

Shell small or medium-sized, slight to moderately elevated spire with an angled or carinate periphery; whorls about 7, flat; nucleus small, sinistral, immersed; the periphery of the whorls is angled and strongly carinated by a beaded and heavy spiral cord; the sculpture of the upper surface of the whorls consists of about 6, beaded, spiral threads, the two bordering the upper suture and one on the lower suture being usually the strongest; the lower surface of the whorl carries about 6 spirals, the inner ones near the umbilicus being the heaviest and strongly nodulated or beaded, the others plain and smooth; the umbilical angle is strongly nodulated.

Greater diameter 22mm.; height 10.5mm.

Remarks.— This species like *A. sullana*, begins in the Saman Eocene and continues into the overlying Oligocene, the type specimens being selected from the Chira formation of the Lower Oligocene. Specimens from different localities show variation in the strength and beading of the spiral cords. In some cases, the beading is of limited development and part of the spirals may be smooth, while in other examples the spirals are coarsely beaded both on the lower and upper surface of the whorls.

Localities and Geologic Occurrence.— Saman formation, Casa Saman; Chira formation, Chira valley, loc. 168.

Family NATICIDÆ Forbes

Genus NATICA Scopoli

Subgenus NATICA s. s.

Natica (Natica) peruviana n. sp. Plate 13, figs. 6, 9, 10

Shell small, generally white, with a smooth shell and form such as typical of *Natica* s. s; diameter of shell somewhat less than the height with a large, inflated body-whorl, which is evenly convex and widest just above the middle; whorls 4 1/2 to 5, those of the spire convex or subangular midway between the close sutures; a fairly distinct flattened band borders the lower side of the upper suture, giving to the spire a more or less scalar aspect; the umbilicus is open, and provided with an internal rib; aperture, large, wide and semilunar, with a small callus above on the body-whorl; surface smooth, the flattened sutural band smooth but sometimes carrying very weak, oblique undulations.

Diameter 10mm.; height 9mm.

Remarks.— This species is a true *Natica,* with an open umbilicus furnished with an internal rib. The body-whorl is large and inflated, and the form of the shell is that of a very small *N. canrena* Linné, except that the flattened sutural band is smooth or only faintly wrinkled.

Locality and Geologic Occurrence.— Restin formation, Jabonillal; Saman formation, Horizon of the Saman conglomerate, near Negritos.

Genus POLINICES Montfort

Subgenus POLINICES s. s.

Polinices (Polinices) woodsi n. sp. Plate 13, fig. 1

Natica (*Naticina*) sp. Woods, 1922, p. 77, pl. 6, fig. 9, pl. 7, fig. 1.

Shell rather large, solid, the height somewhat greater than the width, with a large aperture and rather small, low spire; whorls about 5, the last very large and forming the greater part of the shell; the contour of the last whorl is convex but with a tendancy towards flattening of the sides; umbilicus is wholly or nearly closed with a large, heavy callus which spreads along the parietal wall to the upper junction of the lip; the callus at its junction with the lip is very heavy and usually ridged in direction parallel to the rotation of the whorls; the umbilical region is usually not wholly closed, leaving a small cleft at the lower edge of the callus growth open; aperture semilunar, the outer lip thin and sharp, oblique to the vertical axis of the shell; surface smooth, porcellaneous or marked simply by growth lines.

Height 37mm.; diameter 33mm.
33mm.; diameter 30.5mm.

Remarks.— This species is the first of a group of *Polinices* which have continued through the Peruvian Tertiaries to the present time. In the members of this series, the aperture is very large, the spire small, the parietal callus is heavy and the sides of the body-whorl are more or less distinctly flattened. The umbilicus is wholly or partly closed by a heavy deposit of callus.

P. subangulata Nelson, from the Zorritos Miocene is very similar to the Eocene species, and differs mainly in its somewhat lower spire and the last whorl is more strongly flattened. In the recent Peruvian coastal fauna, an analagous species is the *P. alveatus* Troschel, a fairly common shell on the beach at Negritos and neighboring points. Strangely enough, this shell has apparently escaped the attention of most collectors since Tschudi obtained his specimens from an unknown locality along the Peruvian coast. Tryon in his Manual seems inclined to doubt Tschudi's and Troschel's record, and unites *alveatus* with the common West Indian *mammilla* Linné to which it is very close. In *alveatus* the body-whorl is decidedly flattened and the umbilical callus is less heavy and usually leaves the small funicular umbilicus open. The younger shells have the umbilicus more nearly closed, a condition reminiscent of the earlier fossil shells.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Negritos.

Subgenus NEVERITA Risso

Polinices (Neverita) samanensis n. sp. Plate 13, figs. 4, 5

Shell of medium size, low conic with the height somewhat less than the diameter; whorls about 5, the last very large, strongly convex, greatest about the lower half; spire moderately elevated, the individual spire-whorls are slightly convex and separated by distinct close sutures; the base of the shell is somewhat excavated; the umbilicus partly filled with a large callus, which spreads up over the parietal wall, joining in a large, heavy callus with the upper lip; aperture semilunar, with growth lines.

Height 24mm.; diameter 25mm.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Subgenus LUNATIA Gray

Polinices (Lunatia) vicanus n. sp. Plate 13, figs. 7, 8

Shell small, elevated, thin, with a rather high spire and a small open umbilicus; whorls about 5, the last rather large, moderately convex and widest about the middle; the spire-whorls are strongly convex in profile and slowly decreasing in size to form the small and plainly visible nucleus; the spire is elevated and about one-third the height of the full shell; the upper part of each whorl or a band just below the suture is flattened or depressed, producing a scalar-like aspect to the spire profile; umbilicus small, narrow and open; aperture somewhat more than one-half the length of the shell, semilunar, the outer lip simple and oblique; the inner lip or columella is generally slightly thickened or reflected, leaving the small umbilicus freely open; surface smooth.

Diameter 7.75mm.

Remarks.— A small species, resembling somewhat a small *Ampullina* but the plane of the outer lip is oblique to the axis of the shell. From the Restin of Jabonillal.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Subgenus SIGATICUS Meyer and Aldrich

Polinices (Sigaticus) harrisi n. sp. **Plate 13, figs. 2, 3**

Shell small, with a large body-whorl and a small spire; whorls 5 to 5 1/2, the last very large, convex and widest on the lower half; the spire is short, erect and in size about one-quarter of the height of the rest of the shell; surface is usually white, porcellaneous and marked with fine, revolving lines; these lines are strongest on the zone bordering the upper suture and about the umbilical region, and nearly lacking from a zone about the middle; the umbilicus is nearly closed with a large, thick callus which extends up along the parietal wall to the junction of the outer lip, and at this point, usually carries a small sinus; aperture semilunar, pointed above, rounded below; the outer lip is sharp and in a plane oblique to the axis of the shell.

Height 13mm.; diameter 9.5mm.

Remarks.— The subgenus *Sigaticus* was erected by Meyer and Aldrich[13] with *Sigaretus Bœttgeri* from the Upper Claiborne of Mississippi as type, being the first species described. It differs from the ordinary *Natica* and *Polinices*, by its fine, revolving *Sigaretus*-like spiral lines. Dall considered *Sigaticus*, as a synonym of *Eunaticina* Fischer, but it differs as Harris[14] has maintained by its heavier and typical *Polinices*-like shell. There are several species in the Eocene of the southern United States and it is interesting to find it represented in the contemporaneous rocks of Peru.

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[13] Meyer and Aldrich, 1886, Journ. Cinn. Soc. Nat. Hist., vol. 9, p. 42.

[14] Harris, 1899, Bulls. Amer. Pal., vol. 3, No. 11, pt. 2, p. 87.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Genus AMPULLINA Lamarck

Ampullina ortoni Gabb

Ampullina Ortoni Gabb, 1870, Amer. Journ. Conch., vol. 5, p. 25.
Euspira Ortoni Gabb, 1877, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 8, pl. 35, fig. 3.
Ampullina paytensis Woods, 1922, p. 77, pl. 7, figs. 3, 4.

In 1870, Gabb published a short account of some Tertiary and Quaternary fossils collected separately by Orton and Ramondi at Paita. These collections, on study, were found to contain several recent West Coast species, together with a few new and evidently extinct forms. This association of both living and extinct species led Gabb to believe that the rocks containing them were of Pliocene age, but he also noted that the matrix covering the fossils was different, so that they might have come from rocks of different ages. Field studies, at and near Paita, have shown that Orton's and Raimondi's collections were made from two formations of widely different ages. The recent species and a number of the extinct forms are from the Tablazo limestones of Pleistocene age, while *Ampullina Ortoni* and *Cerithium læviusculum,* both species obtained by Professor Orton, must have been collected from the Upper Eocene Saman sandstones. In the western part of the town of Paita, these two formations lie in juxtaposition, and overlap on the Amotape slates of Pennsylvanian age, which form the coastline to the west of the town.

The typical *A. ortoni,* as figured by Gabb and Woods, is a fairly large species, the mature shell reaching a height of about 60 mm. The upper part of each whorl or along a zone bordering the upper suture is flattened or depressed, but the resulting shoulder of the whorl is rounded. Earlier varieties from the Restin rocks are smaller, the flattening of the upper part of each whorl is stronger and the shoulder of the whorl is more angled.

Lunatia subhumerosa, described by C. A. White[15], from the Provincia de Sergipe and Pernambuco, of eastern Brazil, is probably an *Ampullina,* and its figure resembles quite closely *A. ortoni,* but has a somewhat lower spire and a more inflated body-whorl.

Localities and Geologic Occurrence.— Restin formation, near Negritos, Jabonillal, etc; Saman formation, Lagunitas, Casa Saman (common), Paita (common).

Ampullina gabbi Woods

Ampullina Gabbi Woods, 1922, p. 77, pl. 7, fig. 2a, 2b.

The only specimens, we have of this species are small in comparison to the type shell, described by Woods, and stated as coming from the Negritos formation of Cabo Blanco. At Cabo Blanco, the exposed rocks belong to the upper part of the Pale Gredas and upward through the Cabo Blanco sandstones of Parinas age, into the Restin and Saman. The exact age of the type specimen is therefore not closely fixed.

The specimens in our collection are entirely from the Saman formation. The shells are solid and heavy, and have a general Naticoid appearance. The individual whorls are convex in profile and with deep sutures. The surface of the whorls is faintly to more strongly marked with revolving incised lines. Spire erect.

Localities and Geologic Occurrence.— Cabo Blanco (Woods and Bosworth); Saman formation, Jabonillal, Casa Saman.

Superfamily TÆNIOGLOSSA Bouvier

Family CAPULIDÆ Cuvier

Family CALYPTRÆA Lamark

Subgenus TROCHATELLA Lesson

Calyptræa (Trochatella) aperta Solander

Trochus apertus Sol., 1766, Foss. Hant., p. 9, figs. 1, 2.
Trochus opercularis Sol., idem, fig. 3.
Calyptræa trochiformis Lam., 1802, Ann. du Mus., vol. 1, p. 385, vol. 7, pl. 15, figs. 3a, b, c, d.
Calpytræa trochiformis Deshayes 1824, Coq. Foss. Env. Par., vol. 2, p. 30, pl. 4, figs. 1, 2, 3.
Calyptræa trochiformis Dall, 1892, Trans. Wagner Free Inst., vol. 3, pt. 2, p. 352.

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[15] White, C. A., 1888, Contr. Pal. Brazil, Archivos do Museu Nacional do Rio de Janeiro, vol. 7, p. 183, pl. 16, figs. 5, 6 and 7.

Calyptræa trochiformis Dall, 1915, Bull. 90, U. S. Nat. Mus., p. 103.
Calptræa aperta Harris, 1897, Bulls. Amer. Pal., vol. 2, No. 11, p. 84, pl. 11, figs. 13-16.
Caiyptræa aperta Cossmann and Pissarro 1910-1913, Icon. des coq. fos. de l'Eocene de Paris, pl. 12, fig. 73-1.

Natural to the sedentary habits, the shells of the species of *Calyptræa*, and allied genera are extremely variable in form and the discrimination between similarly sculptured species is very difficult. Species of very similar aspect occur in the Tertiary and recent faunas in most parts of the world and it is a question whether these shells should be considered as strictly conspecific. The reference of the Peruvian fossils to the Parisian *C. aperta* Solander (*C. trochiformis* Larmack), is therefore made with certain hesitation. *C. aperta* has been recorded from the Wilcox and Claibornian Eocene of the southern United States, the Claiborne shell having been described by Conrad as *C. urt.cosum.* Dall gives the range of *C. trochiformis* as extending from the Eocene, through the Vicksburg Oligocene and into the Miocene.

C. (rochatella) ornata Bast. from the Aquitanien Miocene of France, is also very similar to the Peruvian shells. The excellent figures of Cossmann and Peyrot[16] show a shell somewhat larger than the Peruvian, but very similar in sculpture and other features.

The Peruvian shells have generally a low spire, close sutures, rapidly diminishing whorls and a wide, nearly circular, excavated base. In the higher spired varieties, the whorls are more convex, the sutures deeper and the whorls diminish more slowly in size. The under surface of the shell is smooth, with a straight lip such as characterizes the Subgenus *Trochatella* Lesson.

Localities and Geologic Occurrences.— Parinas formation, Keswick Hills; Restin formation, Jabonillal.

Calyptræa saxosa n. sp. Plate 13, figs. 11, 12

Shell irregular, *Crepidula*-like, but with rapidly enlarging whorls, deep sutures and an erect, pointed nucleus; general form as best shown by the figures is elongate, so that a cross-section of the base is broadly elliptical; whorls 2, 3, or more, the lower inflated and large but rapidly diminishing to a very small size on the spire; spire small, erect, pointed and situated a short distance back of the center; surface generally smooth but sometimes obscurely furrowed or folded in a spiral direction; internal characters not exposed.

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[16] Cossmann and Peyrot, 1909-1912, Conchologie Neogenique de l'Aquitaine, p. 483, pl. 13, figs. 32-33, pl. 14, fig. 1

Length 30mm.; height 17mm.; diameter 20mm.

Remarks.— From *C. aperta,* this species differs by its smooth surface and more erect and higher shell and spire. Some broken specimens have much the appearance of a *Crepidula,* except that they have a definite spire and true whorls.

Locality and Geologic Occurrence.—Saman formation, Casa Saman.

Family TURRITELLIDÆ Gray

Genus TURRITELLA Lamarck

Turritella hopkinsi n. sp. Plate 14, fig. 2

Shell very long and slender, with slowly tapering, flat whorls and strong spiral sculpture; whorls very numerous, flat or slightly concave or constricted in a zone, approximately situated at the lower edge of the upper one third of each spire-whorl; the upper suture is bordered below by an appressed belt, often resembling a broad cord and generally over-run by fine spirals; below this appressed band, the surface of the whorl is sculptured with about 6, sharp, spiral threads or ridges, which steadily increase in size towards the lower suture; the three lower spiral threads or ridges are quite strong, the lowest situated in or just above the lower suture; the growth-lines are sinuous as typical of the genus, with a shallow, wide, sinus, the apex of which is directed backwards and lies in the zone just below the upper sutural cord.

Length 32mm.; diameter 14.5mm.

The *T. hopkinsi,* is a species of the Salina formation, to which it is probably restricted. It is usually quite common, but always in a fragmentary condition, and the features of its earlier whorls and the base, are not sufficiently well known for close characterization. From *T. bosworthi* Woods, with which the species occurs, it differs in its slow, gradual taper, and the full-grown, perfect shell must have been extremely long and slender. The strong keel of *T. bosworthi* is lacking on the present shell and in addition the strong cord-like band about the upper suture will help in its recognition.

Locality and Geologic Occurrence.— Salina formation, Negritos.

Turritella iddingsi n. sp. Plate 14, fig. 1

Shell very long and slender, with slowly tapering whorls and a strong sutural cord, along the upper edge of each whorl; whorls very numerous, flat, except for a strong cord closely bordering the upper suture; below the sutural cord, there are 8 or 9, irregular spiral threads, and a fairly wide, concave zone, just above the lower suture; growth-lines are heavy and raised, straight and parallel to the axis of the shell on the lower part of each spire-whorl, but developing a wide, shallow sinus at the upper third; as the growth-lines cross the upper sutural cord, they become more crowded, strongly oblique and give a rope-like appearance to the sutural cord; fine spiral lines cover most of the surface of the shell, and with the aid of the growth lines, develop a trellised-like finer sculpture.

Length 40mm.; diameter 13mm.

Remarks.— Of the Peruvian Turritellas, this species resembles *T. hopkinsi*, most closely, both species having very numerous whorls and a straight and very slender shell. In *T. hopkinsi* the sutural cord is generally weak or simply a wide appressed band, while in *T. iddingsi*, this structure is typically cord-like and sculptured in a rope-like fashion, by the heavy and strongly oblique growth-lines. The spirals on the rest of the shell, are more numerous and of irregular distribution.

The *T. iddingsi* and *restinensis*, are guide fossils for the Restin formation. As in the case of *T. hopkinsi*, the long and slender shell is not adapted for perfect presérvation and usually only fragments of 2 or 3 whorls can be collected.

Locality and Geologic Occurrence.— Restin formation, Negritos, Jabonillal, Restin, etc.

Turritella samanensis n. sp. Plate 14, figs. 3, 4, 6, 7, 8

Shell small or medium size, and when full-grown with whorls closely sculptured with fine, spiral threads; individual spire-whorls gently convex to nearly flat, with deep or close sutures; on the earlier spire-whorls, the sculpture usually consists of about 3, heavy spirals on the center of the whorl, bordered above by three, finer spirals, and below by one or more fine spirals; on the later whorls, the sculpture tends to be subregular with the major spirals numbering 10 or more; the interspaces between the major spirals, generally have a fine spiral thread, together with still finer or submicroscopic spirals; growth-lines not conspicuous, the sinus relatively shallow.

Length 34mm.; diameter 10mm.

From the associated species, *T. samanensis* is distinguished by its gentle, evenly convex whorls and nearly regular sculpture of the later whorls. On young shells the sculpture is heavier and they differ from the young of *T. chira,* in having 3 instead of 2 major spirals, and the whorls are convex and not subangular in profile. The taper of the shell is also more gradual.

T. uvasana Conrad from the Tejon Eocene of California, is quite similar to *samanensis*, but evidently is a larger and coarser species. In the later Tertiaries, the type or group to which *samanensis* belongs, is abundantly represented by numerous species and includes such species as the *T. prenuncia* Spieker of the Zorritos Miocene.

Localities and Geologic Occurrence.— Saman formation, common throughout; Oligocene records to be given later.

Turritella chira n. sp. Plate 14, fig. 5

Shell larger than *T. samanensis,* heavy and with subangular, closely sculptured whorls; the form of the shell is moderately short and stubby with a rapid taper; individual spire-whorls strongly convex or subangular, widest about the lower third; the sculpture consists of about 2 heavy, sharp spirals on the angular portion of the lower third, with the slope above bearing 6 or more finer spirals and still finer intercalated spiral threads; below the 2 heavy, primary spirals, the sutural area is deeply concave and usually smooth; on the early whorls, the sculpture tends to be more regular and with a less number of spirals; characters of the base not shown.

Length 34mm.; diameter 13mm.

Remarks.— The above description applies to the typical form of this species, in which the whorls are strongly subangular in profile and with 2 major, sharp, keel-like spirals. Varietal forms may have the whorls more smoothly convex, and the two major spirals are less strong. The distinguishing characters between this species and *samanensis*, with which it occurs at most stations have been noted in the discussion of that species.

Localities and Geologic Occurrence.— Saman formation, throughout, also abundant in the Peruvian Oligocene.

Turritella boughtoni n. sp. Plate 14, figs. 9, 10

Shell of medium size, with straight flat whorls, slightly overhanging the lower sutures; taper of the shell is at first very gradual, but becomes more rapid on the later whorls; the individual whorls are flat, but the later ones of the full-grown shell, slightly overhang the lower sutures, due to the development of a heavy sutural cord; on the early whorls of the spire, the sculpture consists of two major spirals adjacent to the lower suture and with 4 fine spirals on the portion of the whorl above; on the later whorls, the lower of the major spirals increases more rapidly in size, than the others and eventually developes into a heavy, striated sutural or peripheral cord; the upper of the two major spirals remains small or becomes double in size, and about equal to the spirals above; all the spirals, except the peripheral cord are typically, finely beaded; the peripheral cord is heavily striated with spiral lines; base of last whorl is flattish or slightly convex and with 4 or 5 fine spirals.

Length 45mm.; diameter 13.5mm.

Remarks.— This species is well characterized by its straight whorls, heavy peripheral and sutural cord and fine beading of its upper spirals.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Turritella keswickensis n. sp. Plate 14, figs. 11, 13

Shell small with nearly straight whorls and strong spiral sculpture; sutures distinct and generally lying near the lower side of a deep sutural zone; on the early whorls, the spiral sculpture consists of 3 or 4 cords, slightly heavier below; additional spirals appear on the later whorls, the primary cords increasing to 6 or more, with smaller secondaries in between; fine secondaries cover the whole shell including the sutural zone; the spirals appear faintly beaded; base broken or encrusted with rock.

Length 23mm.; diameter 8mm.

Remarks.— This is a small species quite common in the Parinas sandstones. It is possibly the forerunner of *Turritella boughtoni* or of the series which finally led to the development of the *Turritella altilira* stock in the Miocene. The whorls are typically flat with the spirals finely beaded.

Locality and Geologic Occurrence.— Parinas formation, Keswick Hills.

Family CERITHIIDÆ Menke

Genus CERITHIUM Brug. sensu lato

Cerithium hopkinsi n. sp. Plate 16, fig. 1

Shell large, heavy and rather slender or elongate; whorls 6 or more, strongly shouldered on the upper fourth; above the shoulder and between it and the suture, the surface of the whorl is contracted or irregularly flattened or undulated; the sutures are close and somewhat appressed; below the shoulder, the whorl is nearly flat or very slightly convex, and the surface faintly undulated, as if to form, low and subobsolete ribs; on the lower half of the later spire-whorl, there are 3 or more, widely spaced spiral cords or ridges, the lowest and heaviest, covered by the close sutures and only appearing on the base of the last whorl; the inner lip or columellar area appear to have been strongly thickened; outer lip broken.

Length 134mm.; diameter 47mm.

Remarks.— This is a large, heavy shell with strongly angled or shouldered whorls. The surface appears to have been generally smooth with subobsolete rib-like waves and the lower half of the last whorl with strong, cord-like spirals.

Locality and Geologic Occurrence.— Restin formation, Que. Botija.

Cerithium iddingsi n. sp. Plate 15, fig. 4

Shell large, heavy and very slender; whorls were probably very numerous, but only three are preserved on the type specimen; they are slightly convex in profile with close and more or less appressed sutures; the earliest whorl preserved, has about 8, moderately heavy, knob-like ribs, sometimes with lower and subobsolete curved ribs in between; the ribs are bordered above by a deeper, concave sutural area, which is striated with 5 or 6 spiral threads; on the two following whorls, the knob-like character of the earlier ribs have disappeared and the surface is sculptured with numerous curved riblets which number about 24 on the last whorl; they are subobsolete in character on the surface of the whorl adjacent to the upper suture; the ribs continue across the base of the shell to the columellar region; the upper sutural areas is striated with 5 or 6 spiral lines, as found on the earlier whorls and 4 or 5 heavy, spiral cords encircle the base of the shell; growth lines curved and following the general trend of the sculpture; apertural and columellar characters not preserved.

Length 91mm.; diameter 44mm.

Remarks.— The type of this interesting species is a fragmentary specimen of about 3 whorls. When perfect, the shell was probably quite slender, and the earlier whorls sculptured with more or less knob-like ribs, which become on the later whorls, more numerous, strongly curved and ripple-like. The aperture and columellar portion of the shell is unfortunately not preserved so that the relationship of the species must remain in doubt until better specimens are discovered.

Locality and Geologic Occurrence.— Pale Greda formation, two miles east of Negritos.

Cerithium boweni n. sp. Plate 15, fig. 1

Shell large, heavy, subelongate; whorls straight, coronated above with a rather heavy, wide ridge; which is strongly excavated above by a deep sutural groove; longitudinal sculpture consists of about 14, faint ribs, strongest on the middle of the whorl but fading out both above and below; the upper edge of each whorl carries a wide band or ridge, and below this structure about 5 heavy, spiral ridges separated by deep, wide grooves; on the center of the whorl surface, these spiral ridges are undulated by the longitudinal ribs; 3 or more additional but plain spiral ridges encircle the base of the last whorl; aperture and columella not preserved.

Length 75mm.; diameter 53mm.; fragmentary specimen.

Remarks.— The two specimens in our collection are fragmentary and show only two whorls, but the sculpture is so characteristic that no difficulty will be had in the future identification of the species. The longitudinal ribs are somewhat variable in size and apparently increase in number on older shells.

Locality and Geologic Occurrence.— Pale Greda formation, Restin.

Cerithium xenium n. sp. **Plate 16, fig. 6**

Shell large, heavy and very slender; whorls numerous, the earlier ones nearly flat, but the later ones becoming strongly angled about the middle and the surface of the whorl above, more or less strongly concave, or sloping towards the upper sutures; sutures close, sometimes impressed; the surface is smooth, except for the slightly, bowed or curved growth-lines; the base of the lower whorl has a slight indication of an encircling ridge, above which there is sometimes to be seen, faint spirals or ridges; aperture broken.

Length 80mm.; diameter 31.5mm.; 5 whorls

Remarks.— A very slender, smooth species, the later whorls developing a shoulder and a concave sutural area, such as found amongst the *Turridæ*. It is a species of the Restin formation.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Genus TELESCOPIUM Montfort

Telescopium parinense n. sp. **Plate 17, fig. 4**

Shell Turritelloid, with straight sides and a rapid taper; whorls 8+, with very close, indistinct sutures; sculpture consists of a wide, but not prominent cord bordering the upper suture and below this with 6 additional but narrower spiral ridges; the periphery of the last whorl is angled or keeled and carries the lowest of the 6 spirals described above, and which on the spire-whorls lies just above the lower suture; below the periphery, the base of the last whorl has a wide groove, edged anteriorly by a double spiral, but leaving the rest of the base smooth; growth lines strongly sinuous and recalling those of *Glauconia;* there is a wide and moderately deep sinus like that of *Turritella*, on the upper surface of the whorl, and another deep sinus is found on the base, midway between the periphery of the whorl and the columella; inner lip somewhat calloused above, but broken below on our specimens so that the presence or absence of a columella plication cannot be established.

Length 39mm.; diameter 19mm.; (type)
27mm.; diameter 20.5mm.; (1 1-2 whorls)

Remarks.— In form and general features, this species resembles very closely the *Telescopium fuscum* Chemnitz, a recent species inhabiting the salt marshes at the mouth of certain East Indian rivers, and the type of the genus *Telescopium.*

Locality and Geologic Occurrence.— Parinas formation, Keswick Hills.

Telescopium? samanense n. sp. **Plate 15, figs. 2, 3**

Shell large, heavy, subelongate; whorls 6 plus, generally flat-sided with straight, close sutures and each spire-whorl averaging in height about one-third their width; the periphery of the last whorl is angular and with the base strongly flattened and lying in a plane almost at right angles to the longitudinal axis of the shell; longitudinal sculpture consists of about 10 straight ribs with very wide, shallow but concave interspaces; these ribs generally pass from suture to suture, sometimes in line with each other across the spire-whorls, or more or less off-set; the periphery of the last whorl is angular and carries two spiral ridges, below which the longitudinal ribs do not pass; the flattened base is smooth; columella apparently a little twisted, smooth and without any columellar plication; lip broken.

Length 68mm.; diameter 33mm.

Remarks.— This species and an allied form, described by Woods from Lagunitas as *Telescopium peruvianum,* form a group of species very characteristic of the Peruvian Upper Eocene rocks. They evidently belong to the *Potamidinæ*, although always clearly associated with a truly marine fauna. They differ from typical *Telescopium* by their heavier shell and strong longitudinal sculpture, but until specimens are obtained with the aperture more perfectly preserved, their true relationship cannot be determined.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Family STROMBIDÆ Swainson

Genus ECTINOCHILUS Cossmann

Ectinochilus gaudichaudi d'Orbigny, 1842, Plate 16, figs. 3, 4, 5, 7

Rostellaria gaudichaudi d'Orbigny, 1842, Voyage dans l'Amerique meridionale, Paleontologie, p. 116, pl. 14, figs. 6, 7, 8.

Dientomochilus (*Ectinochilus*) sp. cf. *laqueata* (Conrad) Woods, 1922, p. 92, pl. 12, figs. 3a, 3b.

E. gaudichaudi, was the first fossil described from the true Tertiary rocks of northern Peru. It was originally collected by Orbigny, during his visit to Paita, together with several Pleistocene shells, obtained from the tablazo rocks, exposed in the high sea-cliffs to the east of the town. He described the original specimen as an imprint in a "friable, greenish-yellow Tertiary rock". The origin of this specimen is clearly from the outcrop of the Paita Saman sandstones or in a boulder from the same source.

Woods compared his specimens from the upper Saman sandstones of Casa Saman (10 miles W. N. W. of Sullana), with *D.* (*E*) *laqueata* Conrad[17] from the Claibornian of Alabama. In typical *laqueata,* the anterior canal is strongly curved upwards and backwards, the siphonal fasciole is large, but more confined so that the anterior extremity is only obliquely truncated. The sculpture consists of fine, longitudinal ribs or waves, which occur in a subobsolete manner over most of the surface, but usually lacking in the larger specimens from the ventral side of the last whorl. The posterior canal has more limited developement, it may extend to the tip of the spire in young shells, but in mature forms it is usually continued only about one-half the whorl width, above the upper suture of the penultimate whorl.

E. gaudichaudi, is typically a rather slender species, with nearly smooth whorls, the anterior siphonal sinus is wide; the posterior canal is strongly developed, extending clear to the tip of the spire and often continues down the other side as in the type species, *E. canalis* Lamarck.

Typical *E. gaudichaudi*, is probably confined to the Upper Saman, and reaches a total length of nearly 30 mm. A smaller and more strongly sculptured form, probably a variety of *gaudichaudi* occurs in the basal Saman, or in the horizon of the Saman conglomerate. It differs from true *gaudichaudi,* in its smaller size (length 21 mm.), the spire-whorls are sculptured with fairly strong ribs, which appear continued across the sutures of the earlier whorls, but lacking from the last or body-whorl. The last whorl is often impressed in a *Strombina*-like manner on the right side, and the canal and the lower part of the whorl is strongly sculptured with even spirals . The posterior canal is strongly developed, extending to the apex of the spire and down the opposite side. To distinguish this form, from typical *gaudichaudi,* the varietal name of *alauda* is here proposed.

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[17] Conrad 1833, Foss. Shells Tert. Formations, p. 41, pl. 15, fig. 4.

Length 27mm.; diameter 11mm.; typical *gaudichaudi*
21mm.; diameter 9mm.; variety *alauda*

Localities and Geologic Occurrence.— Saman formation, Casa Saman and Paita (*gaudichaudi*), the horizon of the Saman conglomerate at Negritos (var. *alauda.*).

Genus CALYTRAPHORUS Conrad

Subgenus AULACODISCUS H. Douvillé

Calytraphorus (Aulacodiscus) lissoni H. Douvillé, Plate 18, figs. 1–4

Aulacodiscus lissoni H. Douville, 1921, Compte Rendu somm. Soc. geol. France, No. 14, p. 193, 194, figs. 1-3.

This very singular fossil was described by H. Douvillé from specimens sent to him from Señor M. Lisson of Lima, as a new subgenus of *Calyptraphorus* Conrad. The mature *Aulacodiscus lissoni,* has a subcircular or pebble-like form, the spire wholly covered by a heavy callus and the anterior end is short and in most specimens broken away. The posterior canal is continued as a complete and nearly circular groove near the edge of the ventral face. In younger shells, the callus is less completely developed and the spire and anterior canal are fairly long. These young shells show clearly the relationship of *Aulacodiscus*, with *Calyptraphorus* as suspected by Douvillé.

Aulacodiscus is probably related to *Veatchia carolinea* Maury from the Midway or Lower Eocene of Soldado Rock and Trinidad, but the two known specimens of *V. carolinea,* are imperfect and close comparison is not possible. *Veatchia carolinea* is a larger shell and the posterior canal shows a wide sinus on the right ventral side.

Aulacodosis lissoni, is a very common and characteristic species in the Negritos formation both at Negritos and La Brea. It does not occur in the higher rocks.

Length 32mm.; diameter 27mm.

Localities and Geologic Occurrence.— Negritos formation, Negritos, La Brea.

Family CYPRÆIDÆ Gray

Genus CYPRÆA Linné

Subgenus MONETARIA Troschel

Cypræa boggsi n. sp. Plate 16, fig. 2

Shell of medium size, solid and heavy; base is strongly flattened with a relatively narrow aperture and a large, heavy outer lip; dorsal surface is moderately but not strongly convex with a well-defined or impressed margin or collar, above which the back or center of the shell, rises in a convex, hump-like manner; such as seen in the members of the Subgenus *Monetaria;* the flattened base with four or five, transverse folds or plicæ, on the anterior and posterior extremity, with shorter plicæ in between.

Length 36mm.; height or thickness 16.5mm.; breadth 26mm.

Remarks.— The strongly flattened base, wide outer lip and specially the form of the dorsal surface, suggests that this species is a member of the Subgenus *Monetaria* Troschel of which *C. moneta* Linné, the recent money Cowry is the type species.

The outer lip and the dorsal surface are badly weathered on the single specimen known, so it cannot be determined to which section of *Monetaria,* the species should be referred.

Locality and Geologic Occurence.— Saman formation, horizon of Saman conglomerate, near Lagunitas.

Family OVULIDÆ Fleming

Genus OVULA Bruguieré

Ovula negritensis n. sp. Plate 20, fig. 3

Shell subglobular and in general form similar to the *Ovula ovum* Linné, but probably shorter and more ventricos when perfect; outer lip (broken) projects considerably above the summit of the shell, with the aperture moderately wide and of even width throughout; spire entirely concealed; inner lip and columellar area smooth or feebly marked by transverse growth lines.

Height 37mm.; diameter 25mm.

Remarks.— A single imperfect specimen of this interesting shell has been collected from the Saman conglomerate near Negritos. The outer lip is broken and it is therefore not known whether the lip was crenulated internally as typical of *Ovula* s. s. or smooth as in the Subgenus *Simnia* Leach. The outer lip appears to have been somewhat thickened, projecting above the apex of the shell, and joined with the body-whorl in a heavy, callus-like thickening covering the summit. The inner lip or parietal side of the body-whorl is smooth.

Locality and Geologic Occurrence.— Saman formation, horizon of Saman conglomerate near Negritos.

Family CASSIDIDÆ Adams

Genus CASSIDEA Bruguière

Cassidea maccormacki n. sp. Plate 17, figs. 5, 6

Shell small, solid, with a short spire and a large body-whorl; whorls 4 plus (the earlier spire-whorls lacking from our specimen), those of the spire, convex about the middle and strongly sculptured with vertical ribs numbering about 10 to each volution; the body-whorl is very large and more than twice as long as the height of the spire, strongly but narrowly shouldered, below which the sides of the whorl are straight; the shoulder of the last whorl is armed with transverse folds or ribs, which extend about half way down the sides; there is a finer sculpture of even, coarse, spiral threads, closely spaced or separated simply by deep lines; aperture narrow, the outer lip provided with a heavy varical rib, crenulated within; a large spreading callus is formed on the body-whorl in a typical *Cassis*-like manner, through which the ribs are continued as short, subobsolete folds; a broad shallow sinus is present at the upper edge of the aperture.

Height 26.5mm.; diameter 18mm.; (type)
32mm.; diameter 21mm.

Remarks.— The anterior canal is broken or worn in all our specimens so that the characters of the siphonal canal is not shown. In *Cassis* proper, which this species resembles in most particulars, the canal is short and strongly recurved. The parietal callus is large and spreading, completely covering or concealing the ventral side of the body-whorl. In form and size, the shell resembles *Morum* Bolten (*Oniscia* Sby), of which we have a species from the Chira shales, but differs in its more *Cassis*-like apertural callus.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate, near Lagunitas.

Genus SCONSIA Gray

Sconsia? samanica n. sp. Plate 17, figs. 9, 10

Shell subovate, stout, with a moderate spire, slightly more than one-third the length of the aperture; whorls about 6, the first two belonging to the small but prominent smooth nucleus; the first one-quarter of the first post-nuclear whorl is sculptured with smooth, heavy ribs, but spirals are soon introduced and the transverse ribbing gradually fades until it is nearly absent from the last two whorls; sutures deep, bordered anteriorly by an evident but subobsolete band, formed by the raised edge of the next whorl; the last whorl is large, convex, slightly impressed above so that the profile appears feebly shouldered; the surface is nearly smooth about the middle, or faintly striated, but with heavy or subobsolete spiral threads or cords on the anterior canal and the sutural areas; anterior canal long, curved, with an elliptical aperture, pointed and with a feeble canal at its posterior end; the outer lip is moderately thickened; internal characters of the lip and columellar area not visible in our specimens.

Length 28.5mm.; diameter 18mm.

Remarks.— This fossil is provisionally referred to *Sconsia* because of its resemblance to young shells of the Caribbean Miocene *Sconsia lævigata* Sby. All our specimens have the tip of the anterior canal broken and the aperture completely filled with rock, so the features of these parts is not known.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Negritos.

Family DOLIIDÆ Adams

Genus PYRULA Lamarck

Pyrula otaria n. sp. Plate 17, fig. 3

Shell small, thin, pyriform; spire moderately high of about 6 whorls, the first belonging to the small, smooth nucleus; subsequent spire-whorls are slightly convex, between close, indistinct sutures; the body-whorl is large, evenly convex and passing below or anteriorly into a long canal; sculpture is rather coarsely reticulate or the usual *Pyrula* type of nearly regular, transverse and spiral threads; on the earlier spire-whorls, there are about 4 spiral threads increasing to 7 or more on the later; anterior canal long and slightly curved.

Height 20mm. (fragmentary); diameter 15mm.

The spire in this species is longer than usual in the majority of species of this genus.

Locality and Geologic Occurrence.— Saman formation, horizon of Saman conglomerate, near Negritos.

Superfamily RACHIGLOSSA Gray

Family BUCCINIDÆ Troschel

Genus PSEUDOLIVA Swainson

Pseudoliva parinasensis Woods

Pseudoliva parinasensis Woods, 1922, p. 93, pl. 12, figs. 4-6.

Wood's original specimens came form the Parinas sandstones and his figures are quite typical and illustrate the form and size (about 30 mm.) of the species as it occurs in the Parinas and older beds. The spire is short, acute and erect, partially envolved by the encroaching of the body-whorl and the spiral sculpture is fairly evident over the whole shell. Their full maturity is shown by the great width of the sutural band, lacking or but poorly developed on young shells.

P. vetusta Conrad, ranging through the Midway, Wilcox, Claiborne and Jackson Eocene of the southern United States closely resembles *parinasensis,* but the whorls are more strongly shouldered and its developement is different from the Peruvian. In the earlier beds, the base is simple and imperforate, but in the Upper Eocene or Jacksonian, a very wide umbilicus is developed. It would appear therefore that *vetusta* belongs to a different stock.

Locality and Geologic Occurrence.— Very rare and small in the Negritos formation at Negritos; somewhat more common and larger in the Salina formation at Negritos; fairly common in the Parinas formation near Negritos, Keswick Hills etc.

Pseudoliva parinasensis var. **samanica** n. var. Plate 19, figs. 1-3

In the higher rocks beginning in the Saman and continuing through into the Upper Oligocene, *Pseudoliva* becomes quite common and uniformly of large size. It is evident that these shells represent the continued evolution or development of the *P. parinasensis* stock first begun in the Negritos and Salina formations. Our collection contains a very full series from the Saman Eocene and Oligocene formations.

Young specimens from the Upper Eocene and Oligocene are very similar and seldom can be consistently distinguished from each other. The spire is well-formed, moderately high and acute. The surface is smooth or with only faint spirals and the immaturity of the shell is shown in the slight development of a sutural zone and in the slight callus growth along the upper part of the inner lip. From shells of the same size from the Parinas, the general form is less rotund, and the anterior portion is uniformly narrower.

With maturity, the shells become large, the average size being about 45mm. but larger individuals reach a height of 55 to to 60mm. The callus becomes very large and heavy, spreading upwards so that the last whorl encroaches to a greater or less degree over the earlier spire whorls. In the Oligocene forms, the callus appears earlier than among the Saman shells, and remains continually larger. The form of the mature Oligocene Pseudolivas is therefore broader and stronger shouldered. Since these forms have a truly stratigraphic significance, they are here given separate varietal names.

In the variety *samanica* of the Saman or Upper Eocene, the last whorl is large, inflated and the spire is short, partially concealed by the large enveloping body-whorl. The form of the shell is ovoid, there is no shoulder, and the callus is large, extending as a large mass, above the posterior canal. Surface smooth. In form the shell is quite similar to typical *parinasensis*, but the spire is generally shorter, the body-whorl is proportionately larger, a heavier callus and smoother whorls.

Localities and Geologic Occurrence.— Saman formation, throughout and particularly common in the Saman sandstones of the Chira valley, Paita, and at Bayovar.

Pseudoliva parinasensis var. **mancorensis** n. var. Plate 19, figs. 4, 6

In the Oligocene forms, the mature shells are consistently shorter and more stubby, as illustrated by the figured specimens. The last whorl is strongly shouldered and the shell is distinctly flattened above with a short protruding spire. This variety is the dominating form in the Oligocene strata and occurs in the Chira, Mancora and Heath formations. The average size is about 45mm.

Localities and Geologic Occurrence.— Chira formation, Several localities in the Chira valley, the Sal Chica beds of Punta Sal, Que. Seca, etc: Mancora formation, throughout the Chira valley, Que. Charanal, Lagunitas, the Punta Bravo beds of Punta Sal—Punta Mero, Mancora sandstones near Mancora, etc. Heath formation, the Cone Hill shales of the Chira valley, the Caleto Mero shales of Caleto Mero, etc.

Pseudoliva monilis n. sp. Plate 18, fig. 10

Shell small, oliviform or broad elliptical; body-whorl large and inflated; spire produced, of about 4 whorls, pointed and acute; sutures close, and covered by a narrow, appressed band, with the growth lines directed towards the aperture; the body-whorl is generally smooth above, except for a prominent, crenate or regularly toothed band, which emerges from the suture and encircles the whorl, meeting the outer lip about a third of the distance down from its upper junction; the outer lip provided at the lower one-third with a small tooth which produces a revolving groove as usual with species of *Pseudoliva;* below this groove the surface is marked with 14 or 15, regular, incised, spiral lines; the anterior end of the shell is deeply grooved by the siphonal notch; outer and inner lip free from callus.

Height 18mm.; diameter 10.5mm.

Remarks.— Among our specimens from the Parinas sandstones of Keswick Hills, there is little variation in the size and strength of the crenate band, varying from rather coarse to quite fine. In the Restin of Jabonillal, a varietal form is present, differing from the typical Parinas form, in being somewhat broader and the crenate band is always much finer and thread-like. When perfectly full-grown, this form is quite similar to *P. parinasensis* but the spire is somewhat higher and the fine crenate band is still evident.

Localities and Geologic Occurrence.— Parinas formation, Keswick Restin formation, Jabonillal.

Pseudoliva modesta n. sp. Plate 18, fig. 7

Shell small, thin and in form recalling certain species of *Oliva* of the section *Hiatula;* the body-whorl is large and two-thirds the length of the whole shell; the spire is high, acute and formed of 5 or 6 whorls; the individual spire-whorls are slightly convex and with close, appressed sutures; the body-whorl is encircled about the middle with a strong *Pseudoliva* groove, above which the shell is smooth except for growth lines, and a very faint row of small but distantly spaced nodules such as found on *P. monilis;* below the spiral groove, the shell is strongly sculptured with lines, producing 16 to 17 fairly wide spiral bands; siphonal notch moderately deep.

Height 26mm.; diameter 11mm.

Differs from the preceding species in being thinner, more slender and more typical Oliviform, but obviously belonging to the same group. The carinate band so well developed on *P. monilis* is nearly lacking from the present species but on close examination a few faint and distantly spaced teeth will be seen.

Locality and Geologic Occurrence.— Saman formation, Saman conglomerate, near Negritos.

Pseudoliva mutabilis Woods

Pseudoliva mutabilis Woods, 1922, p. 94, pl. 12, figs. 7-11.

Under this general name, Woods included a group of curious and highly specialized shells, beginning in the Negritos formation continuing through the Salina and Parinas into the Restin. Similar to the group of *P. parinasensis,* a progressive evolution may be followed as the species ascends from the lower to the higher rocks.

Woods's description is based on specimens from the *Turritella* series (Negritos formation), and his figures 7 and 8, represent the typical form and to which the name of *mutabilis* strictly belongs. It is a rare shell and we have no good specimens in our collection. The spire is relatively high, strongly shouldered with very few shoulder tubercles and a callus simply lines the suture of the last whorl. It may be compared with the *P. scalina* Heilprin of the Wilcox of the southern United States, and to the *Harpa dechordata* White from the Maria Farinha beds of eastern Brazil, but this later species seems to be umbilicate.

Locality and Geologic Occurrence.— Negritos formation, Negritos.

Pseudoliva mutabilis var. woodsi n. var. Plate 20, fig. 5

In the Salina formation, and often quite plentiful at the very base of this formation, the shells belong to the form illustrated by Woods's figure 9. The spire is lower, less scalar, the suture deeply canaliculate and the shoulder of the whorl is continuously provided with heavy, but not spine-like ribs or tubercles. The early spire-whorls are ribbed and on the last whorl, the tubercles number about 13. At maturity and to a less extent at earlier resting periods, a heavy callus is formed which spreads a short distance back over the surface of the preceding whorl, covering to a certain extent the finer sculpture; the surface of the whorl is rather strongly sculptured with spiral lines.

Locality and Geologic Occurrence.— Salina formation, Negritos.

Pseudoliva mutabilis var. douvilléi n. var. **Plate 20, fig. 1**

The specimens illustrated by Woods's figures 10 and 11, are stated as being from the Parinas sandstones. I have seen no specimens from the Parinas formation, and I strongly suspect that Woods's specimens were obtained from the basal Restin. At many localities in the Negritos region, the basal Restin is very fossiliferous and unless care is taken in the differentiation between the Restin and Parinas rocks, their fossils may easily become mixed or confused with those of the Parinas. Lithologically the basal Restin may be recognized by its yellow or orange color and rapidly intergrading with the overlying shales.

The variety *douvillei* is the final and most highly specialized member of the *mutabilis* stock. The shell is large, heavy and coarse. The shoulder is sharp and in all of our specimens carries large, coarse, spine-like knobs or tubercles. The callus is very large and heavy, and covering completely most of the surface of the spire whorls, and simulating a broad band or turban. The suture remains deeply canaliculate and the spiral sculpture is obsolete.

Woods's figure 10, is similar to our shells, except that the shoulder of the whorl is simply, sharply angled. In *woodsi*, the callus is formed only at maturity or during brief resting periods, while in the senile and gerontic *douvillei*, the callus is continually formed, except in the very earliest stages.

Locality and Geologic Occurrence.— Restin formation, Negritos.

Genus TRITONIDEA Swainson

Tritonidea staufti n. sp. Plate 17, fig. 11

Shell of medium size, buccinoid with an elevated, acute spire and a moderately long, anterior canal; whorls about 6 (plus with the broken nucleus), the spire-whorls slightly convex in profile and sculptured with wave-like ribs and moderately heavy, subregular spiral threads; body-whorl large, inflated, strongly convex about the center, and contracted about the base into the moderately long anterior canal; sutures distinct, often bordered anteriorly by a cord or the elevated edge of the whorl; sculpture of last whorl similar to the preceding but with the ribs more wave-like and developed only on the upper half of the whorl; the spirals are strong, subregular and with wide interspaces; aperture large, broadly subelliptical, the outer lip apparently thickened but its internal characters concealed.

Height 28mm.; diameter 17mm.

Remarks.— In form and general texture, this shell resembles certain species of *Cominella*, rather than those of *Tritonidea.* The anterior canal is moderatetly long and there is no keel or encircling ridge above the trace of the siphonal sinus. Our specimens are all incomplete, usually with the anterior canal broken or imbedded in rock.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Genus ALECTRION Montfort

Alectrion salina n. sp. Plate 18, fig. 13

Shell small, elevated with 4 smooth nuclear and 4 subsequent whorls; the nuclear whorls pass insensibly into the post-nuclear, the transverse sculpture beginning within one-fourth of a turn as fine, raised threads with wide intervals, faintly marked with 4 or 5 incised spiral lines; the transverse sculpture consists on the last whorl of 9 to 11, strong, rounded ribs which begin on the canal and continue straight to the suture; on the post-nuclear whorls of the spire, the transverse ribs are strong and straight from suture to suture; the spiral sculpture consists on the spire-whorl of 6 to 9 threads which faintly nodulate the rounded summit of the ribs; on the last whorl there are 19 spiral threads; outer lip not thickened; anterior canal slightly twisted, with a strong siphonal notch.

Length 12.5mm.; diameter 6mm.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Negritos.

Alectrion terebratula n. sp. Plate 18, figs. 14, 15

Shell small, elevated, with 4 nuclear and 3 subsequent whorls; the nuclear whorls are smooth except on the last one-half turn which is marked with fine, raised thread-like riblets and faint spiral grooves or threads; the transverse sculpture on the post-nuclear whorls consists of heavy ribs with wide interspaces and number on the last whorl about 6 or 7; the spirals consists of strong revolving threads between wide, regular intervals; they number on the spire-whorls 4 or 5, and on the last whorl 11 or 12, with additional and more crowded spiral threads on the canal; the spirals cross the summit of the ribs, the intersections being subnodulous or rough; there is generally a strong, sutural cord or spiral above which the ribs do not extend; outer lip not thickened; canal slightly twisted and with a strong siphonal notch.

Length 11mm.; diameter 5.75mm.

Remarks.— Differs from the preceding species, by its harsher and more Muricoid type of sculpture.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Negritos.

Genus DORSANUM Gray

Dorsanum parinense n. sp. Plate 18, figs. 5, 6

Shell small, Columbelloid in form; spire long of about 5 or 6 whorls, pointed, acute and equal in length to the aperture; whorls nearly flat, the suture emarginated with a narrow band; last whorl rather large, the base strongly contracted so that its form is quadrate; surface smooth, except for a narrow, sutural band; anterior canal short with two strong spiral ribs or keels on each side of the siphonal groove; outer lip thin, the inner provided with callus, and a small sharp keel or plica on the anterior of the columella.

Length 22.5mm.; diameter 12.5mm.

Remarks.— In *Nassa lagunitensis* Woods, the shell is nearly smooth, or banded with incised spiral lines, the siphonal sinus is deep and bordered on the posterior side by a sharp keel or rib which encircles the beak or anterior canal. The shell is Columbelloid and resembles closely the species generally placed in the genus *Dorsanum* Gray. They differ from *Bullia* Gray, in having the sutures distinct and free from a cover of enamel.

Dorsanum lagunitense Woods is a common and characteristic Upper Eocene species. In the basal Saman, the shells are usually small, averaging from about 19 to 20mm. Woods's type specimens which came from the Lagunitas sandstones higher in the section, are larger between 30 to 32 mm. in height. In the Saman sandstones of the Chira valley, at the top of the Saman formation, the average size is still larger and individuals reaching a length of 40mm. are common. Except in matter of size, there is no other change of importance.

From *Dorsanum lagunitense,* the *parinense* differs by its smaller size, the last whorl is less evenly convex and the base sharply contracted so that in contour, the form is quadrate. The surface appears perfectly smooth, except for a narrow sutural band.

Locality and Geologic Occurrence.— Parinas formation, Keswick Hills.

Genus MELONGENA Schumacher

Subgenus CORNULINA Conrad

Melongena (Cornulina) levifusoides n. sp. Plate 17, fig. 1

Shell short fusiform, with a moderately high conic spire and shouldered, tuberculate whorls; whorls 6 or 7, the earliest spire-whorls with heavy, transverse ribs which on the succeeding whorls become tubercular and finally develop into stout spines; the zone between the suture and the shoulder is free from transverse sculpture; a second row of small spines is present on the body-whorl a short distance below the shoulder and emerges from the upper end of the aperture or suture; a fine, somewhat decussated sculpture of spiral lines is present above the second or lower row of tubercules; anterior canal with heavy spirals; aperture not preserved in the type specimen.

Height 35mm.; diameter 26mm.; (broken)

Remarks. — This is a long ranging species beginning in the basal Salina formation and continuing through the Parinas and Restin into the Upper Saman. A specimen from the Upper

Saman sandstones has been selected as the type, because of its better preservation, but except in the height of the spire, there is no other important variation to be noted between the shells from the different horizons.

In the majority of specimens, the anterior canal is broken, and they were at first thought to belong to the genus *Levifusus*. More complete specimens from the Parinas and Salina formations show a short, twisted or curved interior canal, a strong rib or basal fold and probably a perforate base. The *Fusus minax* Solander from the Bartonian of the Parisien Basin is very similar to the present species. It is referred to *Melongena* (*Cornulina*) by Cossmann and Pissarro (Cat. fossiles de l'Eocene, pl. 39, fig. 191-1). Direct comparison with specimens of *Fusus minax* in the Cornell Museum, show that the large Parisien shells have a somewhat longer anterior canal and stronger spines, but the young shells are extremely similar.

Localities and Geologic Occurrence.—

Salina formation, Negritos.
Parinas formation, Balcones Point.
Restin formation, Jabonillal.
Saman formation, Casa Saman.

Subgenus PUGILINA Schumacher

Melongena (Pugilina) œdicnema n. sp. Plate 17, fig. 2

Shell of medium size, Fasciolaroid; spire rather high, with strongly shouldered whorls, armed with short but stout, node or keel-like spines; sutures close; whorls 6 or more, strongly shouldered, the last or body-whorl with about 9, strong, broad node-like spines, sometimes continued below towards the base of the shell as low, subobsolete, transverse folds; the area above the shoulder is impressed or slightly concave, smooth and generally free from any sculpture except growth lines; the surface, from the shoulder angle and over the base and anterior canal, is sculptured with wavy, unequal spirals divided into a widely spaced primary set and with finer secondaries in between; anterior canal moderately long, curved with a feeble, encircling basal rib or fold; aperture Fasciolariod, widest at its posterior one-third, and continued anteriorly into a short, curved canal.

Length 39mm.; diameter 26mm.

Remarks.— The *Fusus subcarinatus* Lamarck, from the Bartonian of France, and referred by Cossmann to *Melongena* (*Pugilina*) Essais de Paléoconchologie, vol. 4, p. 88, pl. 4, fig. 11, is very similar to this species. Judging simply by the published figures, the French shell was somewhat stouter, the fold on the anterior canal is heavier, and the base is feebly perforate. In the only specimen we have showing the anterior canal, the base is imperforate, but in the other characters, *œdicnema* is very close to *subcarinatus* and they are unquestionably congeneric.

Locality and Geologic Occurence.— Saman formation Casa Saman.

Family FUSIDÆ Tryon

Genus CLAVILITHES Swainson

Clavilithes pozœnsis n. sp. Plate 21, figs. 6, 8, 9

Shell fusiform, the spire acute and longer than the anterior canal; whorls 6 or more, convex, often subangled about the middle and with the portion of the whorl immediately below the upper suture contracted or excavated; the spire whorls are sculptured with about 8, transeverse ribs or swellings which are strongest on the middle of the whorl but lacking from the upper sutural area; the surface of each spire-whorl is overrun with 13 or 14 spiral threads with much wider intervals; the spirals and the regular, transverse growth-lines together form a fine, trellised-like sculpture which is best displayed on the spire-whorls and on the upper part of the body-whorl; on the body-whorl, the transverse sculpture is absent or obsolete, with the spirals strongest on the upper part of the whorl and the anterior canal, nearly smooth in the middle; anterior canal straight; aperture narrow or contracted, the inner lip with a pronounced callus the inner edge is free or shelf-like.

Height 40mm.; diameter 15.5mm.

Remarks.— In general form, this shell does not resemble the majority of species of *Clavilithes,* and it is with some hesitation that I am referring it to that genus. It resembles *Clavilithes* rather than other Fusoid genera, in its comparitively short anterior canal, the shelf-like edge of its inner lip and in features of its aperture. Certain Parisian species of *Clavilithes* of the subgenus *Cosmolithes* Grabau, are remotely similar to the Peruvian species, but in that group, the columella is provided with a single sharp plication.

C. peruvianus Woods of the Salina — Parinas, differs by its larger size, finer sculpture and in lacking the transverse ribbing except on very young shells. The Saman species is peculiar in its apertural characters. The inner lip is provided with a large, protruding leaf-like edge and the outer lip is generally strongly impressed as if through crushing.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Lagunitas, and a few miles north of Negritos.

Clavilithes woodringi n. sp. Plate 21, figs. 1-3

Shell robust, with a moderately long, acute, spire; whorls 7 or more, the earlier ones more or less angled above and with deep, excavated sutures; the individual spire-whorls are cylindrical in form, nearly three times as wide as high; earlier spire-whorls are sculptured with 6, transverse ribs or swellings and fine spirals, but this sculpture rapidly becomes obsolete and the later whorls are smooth, except for faint and irregular, spiral lines or threads; the later whorls are less distinctly shouldered and the sutures are more deeply and narrowly excavated or canaliculate; last whorl is very large, cylindroid, and the base is strongly contracted to form the anterior canal.

Height 42mm.; diameter 33mm.; (type fragmentary)
43mm.; diameter 25.5mm.

Remarks.— The above description is based upon a number of imperfect specimens from the Saman conglomerate near Lagunitas. It differs from the *C. pacificus* Woods of the Restin and Parinas, in its higher and more cylindrical whorls and proportionately longer spire. Among European species, it is quite similar as may be expected to *C. macrospira* Cossmann of the Parisian Eocene and to *C. solanderi* Grabau from the English

Barton beds. From these European species, the Peruvian shell appears to have been more slender and the whorls more cylindrical.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Lagunitas.

Clavilithes lagunitensis n. sp. Plate 21, figs. 4, 7

Shell of moderate size, heavy, with a conic spire and a somewhat longer body-whorl and canal; whorls 6 or more; the earlier spire-whorls are sculptured with 5 or 6 strong, transverse ribs or swellings, fine spirals and a subobsolete sutural cord at the upper edge; on the later whorls the transverse ribs have become obsolete, the upper part of the whorl is strongly shouldered by a shelf-like or flattened band which follows just below the upper suture; sutures channeled or canaliculate; the shoulder of the whorl is angled or strongly carinate; the whole surface of each whorl is covered with fine, revolving spirals, weak on the middle of the body-whorl; anterior canal straight and the columella provided with two plications.

Height 42mm.; diameter 30mm.; (type)
53mm.; diameter 24mm.

Remarks.— This species appears to be a direct descendant of the earlier *C. incertus* Woods of the Salina - Parinas formations. It differs by its larger size, and in details of sculpture and form. In *incertus,* the portion of the whorl immediately below the shoulder is deeply contracted or sunk, and the carinate shoulder is heavier and more cord-like in appearance.

Woods in his description of *incertus,* compared it with the *Rhopalithes Noæ* Chemnitz from the Parisian Eocene and noted the indication of a columellar plication. In a cross-section of one of our specimens, the columella is shown with two strong oblique plications. *Rhopalithes* was proposed by Grabau, as a generic form distinct from *Clavilithes,* in the shape of its protoconch and in having two columellar plications. In addition to *R. Noæ* the type species, there are several other forms in the European Eocene, but *incertus* and *lagunitensis,* seem to be the first species of the *Rhopalithes* series to be recorded form America.

Locality and Geologic Occurrence.— Saman formation horizon of the Saman conglomerate near Lagunitas.

Xancus peruvianus n. sp. Plate 21, fig. 5

Shell large or medium size, solid and heavy; spire about the length of the aperture with 4 plus whorls (the tip broken); whorls narrowly shouldered and the shoulder angle armed with numerous, feeble ribs or nodes, strongest on the spire whorls; the area between the shoulder angle and the suture is slightly concave or excavated and with an appressed band or feeble cord about the suture; below the shoulder, the sides of the spire-whorls are straight; the side of the body-whorl is straight, contracted in the region of the base and then prolonged into the long, anterior canal; sculpture as noted, consists of feeble ribs or nodes on the shoulder angle, roughly numbering about 15 to 17 on the last whorl, and weak irregular spiral threads, lacking or subobsolete from the middle and upper part of each whorl, but strong and heavy on the anterior canal; inner lip with a wide, spreading callus and the columella is provided with three strong plicæ, the upper 2 being stronger.

Height 85mm.; diameter 47mm.; (Chira Shales)

Remarks.— In describing this species, I have selected as the type form, a specimen from the Chira shales of Lower Oligocene age. In the Upper Eocene, the species occurs in the Saman formation, and a few very poorly preserved specimens have also been found in the Restin sandstones of Upper Middle Eocene age. The Eocene shells are not well preserved but differ only in a varietal degree from the Oligocene forms. In the Saman specimens, the sculpture is somewhat coarser, the shoulder ribs or nodes are heavier and more persistant and the size of the shell is less.

The discovery of a typical *Xancus* in the Peruvian Eocene, extends the known stratigraphic range of this genus from the Lower Oligocene into the upper part of the Middle Eocene. The *X. wilsoni* Conrad from the Vicksburg Oligocene, is quite similar to *peruvianus,* but it differs in having a less pronounced shoulder and the sutural area is wider.

Localities and Geologic Occurrence.—

Restin formation.
Saman formation, Caleto Sal, Casa Saman.
Chira formation, Chira shales near Casa Saman.

Genus VOLUTA Linné

Subgenus PERULUTA n. subg.

The following is a description of the subgenus *Peruluta.* Type, *Eovasum peruvianum* H. Douvillé.

Shell Fulguroid to short Volutiform, whorls strongly shouldered, typically bearing spine-like tubercles or extensions sometimes lacking; spire-whorls free or covered with callus; columella with 3 strong, slightly oblique and *Voluta*-like folds; a deep siphonal notch, bordered on the posterior side by a strong, encircling ridge or keel, a deep anal or posterior sinus adjacent to the suture.

Voluta (Peruluta) peruviana H. Douvillé

Eovasum peruvianum H. Douville, 1921, Journ. de Conchyliologie, p. 3, 4 pl. 1, figs. 4-5.

Volutospina peruviana Woods, 1922, p. 101, pl. 14, figs. 5-7; pl. 15, figs. 1-5

H. Douvillé referred this species to his genus *Eovasum,* the type of which, is the *Turbinella frequens* Mayer-Eymar[19] from the Eocene of Egypt. Douvillé's Peruvian specimens were fragmentary and superficially they resemble quite closely the type species *E. frequens,* but they differ in having 3 instead of 4 columellar folds and particularly in lacking the heavy, *Melongena* or *Vasum*-like cord about the base of the shell. More perfect specimens, than those which Douvillé had for study, clearly show as Woods has maintained, that the relations of these fossils are with the Volutids, but without fully agreeing with any of the established generic or subgeneric types. From *Volutilithes* Swainson (*Plejona* Bolten), and its subgenera, they differ in their strong, columellar plicæ, deep siphonal notch which is bordered on the posterior side by a strong keel. These characters relate the shells with the true *Voluta* Linné. The protoconch is not preserved in our specimens but it was probably small. From *Voluta* Linné, the Peruvian shells differ markely in form, being shorter and more stubby or Fulguroid (*V. mancorensis*), with a sharp shoulder, free or provided with strong, spines or tubercles. *V. peruviana* is strongly phylogerontic and in the middle and upper portion of its geologic range, gerontic characteristics are developed in early life, such as the spreading of a heavy callus deposit over the spire-whorls.

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[19] Mayer-Eymer, Journ. de Conchyl. vol. 43, p. 47, pl. 2, fig. 7; vol. 66, p. 1, 2. pl. 1, figs. 1a, 1b.

This species and its varietal forms are among the commonest and most characteristic fossils of the older Peruvian Eocene. Beginning in the Negritos formation, the species ascends as high as the Lower Saman. It early begins to assume gerontic characteristics, which appear earlier and earlier in the higher beds, and upon these features, two principal varieties, aside from the typical form may be recognized. These varieties have a distinct stratigraphic significance and have been carefully described and figured by Woods but grouped together under the same specific name of *peruviana*.

Douvillé and Woods' description applies best to specimens from the Negritos formation, which should therefore be selected as the typical form. The shoulder ridge is strong and bearing 9 or 10 spine-like tubercles, which are equally as strong on the spire-whorls. The callus deposit is lacking or very slight.

In the Salina formation, the callus covers the greater part of the spire-whorls, usually leaving the tip of the spire and the earliest whorls free. The shoulder of the last whorl is provided with heavy tubercler or spines which are covered by the callus or submerged by the sutures. The spire in uniformly low. This variety is most common in the Salina formation or the basal *Clavilithes* series and should be designated as variety *salinensis* n. var. It is represented by Woods' figures 1 and 2, on plate 15.

The variety *salinensis*, continues into the Parinas (fig. 4, plate 15, of Woods). In the Parinas however, we find the introduction of a third form, illustrated by Woods' figures 3 and 5 and our own on plate 22, figs. 4, 5. (also pl. 16, fig. 8). It reaches its best development in the basal Saman but shortly disappearing and its place being taken by *V. mancorensis*. In this variety the callus is developed to an extreme, often covering the entire spire in an *Orthaulax*-like manner. The shoulder of the whorl is rounded, entirely free from spines, and the sutures are closely appressed. It should be specially noted that even in very young shells from the Parinas (length 19mm.) and apparently at all stages in the basal Saman, the shoulder is well-rounded, smooth and with a heavy deposit of callus. This variety should be designated as var. *samanica* n. var.

Locality and Geologic Occurrence.— Negritos formation, Negritos, La Brea (typical form); Salina formation, Negritos, L Brea, (var. *salinensis*); Parinas formation, Negritos, (var. *salinensis* and *samanica;* Restin formation, variety *salinensis* and *samanica* Jabonillal; Saman formation, horizon of the Saman conglomerate near Negritos, var *samanica.*

Voluta (Peruluta) mancorensis n. sp. Plate 22, figs. 1, 3

Shell large, heavy, Fulguroid; spire low, but elevated and acute; whorls about 6, strongly sculptured and with large, heavy spine-like tubercles, which number on the last whorl from 9 to 11; the tubercles and spines are confined to the shoulder angle, leaving the sutural area smooth as well as the surface of the whorl below the shoulder; aperture is sub-elliptical, widest at the lower on anterior one-third; in mature shells the anal sinus is deep and narrow, lying along the upper suture; inner lip or body of the whorl is free from callus, except as a very thin deposit in certain large specimens; columella with three strong, more or less oblique plicæ, the posterior or upper one being the largest; anterior or siphonal sinus is fairly deep, bordered above by a sharp ridge which is continued as a sharp keel or rib around the anterior canal, ending midway between the upper and second columella plicæ; the trace of the siphonal sinus is bordered below or on the anterior side by a second and strongly oblique rib, and a faint fold is developed above the upper keel.

Height 62mm.; diameter 41mm.; (type)

Remarks.— The relations of this shell is clearly with the stock of *V. peruviana.* In addition to its much larger size, it differs from *peruviana* by its generally higher spire, more flaring outer lip and the general lack of callus deposit on the body-whorls and over the spire. *V. mancorensis* is a relatively stable species and in its long range through the Upper Eocene and Oligocene beds, it shows no important changes or variations. *V. peruviana* on the other hand belongs to a highly phylogerontic stock and became extinct in early Upper Eocene times.

Locality and Geologic Occurrence.— Saman formation, quite common specially in the Upper part, as the Saman sandstones of the Chiro Valley and Paita; Chira formation, several localities in the Chira valley, the Sal Chica beds of Punta Sal etc; Mancora formation, Chira valley, Mancora, Punta Sal etc; Heath formation, Caleto Mero, Mancora.

Genus LYRIA Gray

Lyria sabulosa n. sp. Plate 17, figs. 7, 8

Shell elongate-ovate, with a long, relatively narrow aperture and a shorter spire about one-half the length of the aperture; the nucleus is rather large, obtuse and formed of three, smooth whorls, followed by two or more subsequent whorls; sutures appearing canaliculate or excavated by a slight coronation of the upper edge of the whorls; spire-whorls, except the nuclear are flat and divided by the excavated sutures; last whorl, large, but not inflated, evenly convex passing anteriorly into a moderately long and somewhat twisted, anterior canal; the sculpture consists of even, transverse ribs or waves, often continuous across the whole shell, but on the larger shells, subobsolete on the base; aperture long and narrow, the outer lip thickened with an external rib; anterior or siphonal sinus was probably moderately deep, showing in the growth lines or the canal as a strongly, oblique band, bordered on each side by a low rib; columella concealed.

Height 37mm.; diameter 20.5mm.

Remarks.— A very common and characteristic species in the Saman conglomerate. It differs from *Lyria mississippiensis* Conrad[20] from Vicksburg by its generally larger size and deeply excavated sutures.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate, Negritos, near Lagunitas.

Family OLIVIDÆ d'Orbigny

Genus OLIVELLA Swainson

Olivella vicana n. sp. Plate 18, figs. 11, 12

Shell small, smooth, with a moderately high, acute spire; whorls about 7, the first 3 belonging to the small, obtuse nucleus; the post-nuclear spire-whorls are flat or straight-sided and separated by deep, canaliculate sutures, above which there is often a bordering, narrow band of callus; body whorl large, slightly convex, widest about the middle; surface smooth generally white or faintly blotched; aperture narrow, widest anteriorly and nearly two-thirds the full length of the shell; outer lip sharp, pillar straight; the anterior or siphonal sinus is deep and with a broad fasciole, with 2 strong, oblique ribs at the lower end of the columella.

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[20] Conrad as *Fulgoraria mississippiensis*, Journ. Acad. Nat. Sci. Phila. vol. 1, pl. 13, fig. 1.

Length 16mm.; diameter 6mm.

Remarks.— A very common species in the Restin rocks of Jabonillal. According to figures, it resembles closely the *O. mitreola var. mucronata* d'Orbigny from the Parisian Eocene, but our shells are somewhat larger.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Genus OLIVANCILLARIA d'Orbigny

Subgenus AGARONIA Gray

Olivancillaria (Agaronia) saxosa n. sp. Plate 18, figs. 8, 9

Shell rather slender with a high spire and deep, canaliculate sutures; the spire is high and pointed and slightly less than one-half the total length or height of the shell; whorls 5 plus (the apex broken in all our specimens) and separated by deep, grooved or canaliculate sutures; between the last and the penultimate whorls, the sutures may be bordered above by a callus thickening which passes a short distance down along the parietal side of the aperture; the last whorl is subcylindrical in form and slightly convex just above the middle and it carries about the lower or anterior one-third, a wide band, and below this, two grooves, the lower of which passes into the siphonal sinus; aperture comparatively narrow, widest about the middle.

Height 45mm.; diameter 15mm.

Remarks.— Our specimens are fragmentary and the surface of the shell weathered and eroded. From *Oliva alabamensis* Conrad from the Claiborne Eocene, it differs in being more slender, the body-whorl is less convex and the aperture appears to be narrower. According to Cossmann, two typical species of *Agaronia* occur in the Eocene of the Basin de Nantes;

O. Dubuissoni Vass., and *O. oxyspira* Cossm. *O. Dubuissoni* resembles the Peruvian species quite closely but the penultimate whorl is wider and the shell is less slender.

Locality and Gological Occurrence.— Saman formation, Saman congl., near Lagunitas.

Subclass EUTHYNEURA

Order OPISTHOBRANCHIA Milne Edwards

Family AKERATIDÆ Pilsbry

Genus HAMINEA Leach

Haminea labrea n. sp. Plate 20, fig. 6

Shell thin, broadly ovate, ventricose; body-whorl very large and completely enveloping the shell with each volution; aperture rather wide, contracted or narrowed posteriorly and continued to and above the summit of the shell; the summit of the shell is slightly concave in the center but apparently not umbilicate; external surface appears to have been smooth.

Height 44mm.; diameter 34mm.

Remarks.— Two specimens of this species, partly internal casts have been collected from the *Turritella* beds of La Brea. In size and general form, this species recalls the *Haminea grandis* Aldrich from the Jackson Eocene, but the Peruvian species appears to have been smooth. The substance of the shell was probably very thin, and for this reason, the shells are referred to *Haminea* rather than to *Bullaria* Raf.

Locality and Geologic Occurrence.— Negritos formation, La Brea.

Haminea solaria n. sp. Plate 20, figs. 2, 4

Shell large, ventricose, broadly-ovate or subspherical in form; aperture wide, full and not extending much above the summit of the shell; summit is somewhat flattened with a narrow, deep umbilical-like pit.

Height 65mm.; diameter 59mm.

The type specimen is an internal cast from which all trace of the original shell has been removed and the surface of the cast is encrusted with patches of worm tubes. The general form of the shell may be gained from the specimen and because of its unusual size, and relations with the preceding species, it is worthy of notice.

Fron *H. labrea*, it differs by its large size, more subspherical form and wider aperture. The cast shows a narrow, deep, umbilical-like pit in the summit, but on the external shell, this pit may have been shallow as in *H. labrea*.

Locality and Geologic Occurrence.— Restin formation, base of formation at Balcones Point.

Class CEPHALOPODA

Order NAUTILOIDEA Zittel

Family CLYDONAUTILIDÆ Hyatt

Genus HERCOGLOSSA Conrad

Hercoglossa peruviana Berry **Plate 23, fig. 1**

Hercoglossa peruviana Berry, 1923, Amer. Journ. Sci., vol. 6, p. 427-431, figs. 1, 2.

This fine Nautilod, described by Professor Berry from specimens sent to him by Senor Jose J. Bravo of Lima, is quite common near the top of the Restin sandstones at Lobitos. It seems to be strictly limited to this horizon, and from its abundance at its type locality, the coastal point near by, has been named Punta Nautilus by the Lobitos geologists and engineers. The species becomes very large and specimens attaining a maximum diameter of 2 to 300 mm. are not uncommon. A small specimen has been figured to show the strong suture lines and for more ready comparison with the Peruvian species of *Eutrephoceras*.

H. peruviana is obviously most closely related to *H.* (*Enclimatoceras*) *ulrichi* White from[21] the Midway Eocene of the southeastern United States. *H. ulrichi* differs from *peruviana* as pointed out by Professor Berry, by its usually smaller size, narrower venter, more inclined sides, in its smaller and more centrally located siphuncle, and in details of its suture lines.

Locality and Geologic Occurrence.— Restin formation, Lobitos.

Genus ATURIA Bronn

Plate 24, figs. 1, 3
Plate 25, figs. 1, 6

Of the Peruvian Nautiloids, *Aturia* is the most common and widespread. The earliest specimens occur at the very base of the Salina formation, where they are often quite common, but generally so encrusted with a sandy matrix, that for a long time their true relationship could not be established. No specimens have as yet been discovered in the Pale Gredas or Parinas sandstons, and their next occurrence is near the top of the Restin sandstones at Lobitos, associated with *Hercoglossa peruviana* Berry. In the Upper Eocene, Aturias are fairly common, and have been collected from several horizons within the Saman formation. The Saman conglomerate specimens are usually very small and immature, but at several localities in the Saman sandstones of the Chira valley, they are quite large, fully 2-300 millimeters or more in diameter. They continue to be fairly common fossils throughout the Peruvian Oligocene and are recorded from several localities in the Chira, Mancora and Heath formations. In the Mirador sandstones and conglomerates of the Chira valley, and considered as of Middle Oligocene age, Boughton has collected specimens nearly as large as those of the Upper Saman sandstones. No Aturias have been discovered in the Peruvian Miocene to date.

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[21] White, C. A., U. S. Geol. Survey, Bull. 3, p. 17, pls. 7-9.
Harris, G. D., Bulls. Amer. Pal., Vol. 1, No. 4, p. 236-239, pls. 13, 14, 15.

The Genus *Aturia* was established by Bronn, in 1838, with *A. zic-zac* Sowerby and Eocene fossil from the London clay as the type species. Fischer[22] credits the genus with 6 species, widely distributed in the Eocene-Miocene rocks of Europe, Egypt, India and North America. Most of the species are very similar, and it is still a question, how many really distinct species should be recognized. Of the Eocene forms, the contour of the shell is always very similar as well as the minute details of the suture lines. The characters of the funnels and siphuncle have greater value but are less commonly preservd. For comparing the Peruvian Aturias with the described and figured species in the literature, use has been made of the relative proportions of the greater diameter of the shell to the semi-thickness. These proportional values seem to be quite constant and reliable.

The typical English *A. zic-zac*, as figured by Sowerby and Edwards[23] is a small species, rather ventricose and with an elongate-elliptical aperture. Its proportion is in the ratio of 1 to 4.8. A large species nearly equaling the Saman sandstone specimens in size, was described by Parona[24] as *A. rovasendiana* from the Upper Eocene rocks of the Italien Piedmonte. The suture lines as figured agree exactly with the Peruvian Aturias, but the shell is more strongly compressed, with a proportional ration 1 to 7.

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[22] Fischer, 1887, Manuel de Conchyliologie, p. 415.

[23] Edwards, Eocene Mollusca, Paleontographical Society of London, vol. 21, p. 52, pl. 9, figs. 1, 2.

The Eocene rocks of the Atlantic coastal plain of the United States, have two described species of *Aturia*, the *A. alabamensis* Morton[25], from Claiborne Alabama, and the Castle Hayne marls of South Carolina, and *A. vanuxemi* Conrad from the greensand marls of New Jersey. *A. alabamensis*[26] is very similar to *vanuxemi*, but it differs in being somewhat less compressed and in the shape of the siphuncle.

Whenever, preserved, the suture lines of the Peruvian Aturias are similar in every detail with those figured for the European and American Eocene species. The siphuncle is quite small and situated closely adjacent to the venter of the next inner volution. The funnels are long, uniting to form a long, continuous and relatively small siphuncle tube, lying on or just above the venter of the inner volution. The exterior is smooth, with strongly curved growth lines, on the sides strongly convex forward and uniting on the venter to form a wide, shallow sinus.

The proportional ratio of European and American Eocene species compared with the Peruvian specimens is as follows:

A. zic-zac Sowerby, portion 1 to 3.
A. rovasendiana Parona, porportion 1 to 7.
A. alabamensis Morton,[27] porportion 1 to 4.3.
53-56 Taf. III
A. vanuxemi Conrad porportion 1 to 6.
The Peruvian porportions:
The Salina formation specimens porportion 1 to 3.

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[24] Parona, Celalopodi terziara del Piemonte, Pal. Italica, vol. 4, p. 157, pl. 12, fig. 1, pl. 13, fig. 1.

[25] Morton, Synopsis of the organic remains of the Cretaceous group, p. 33. pl. 18, fig. 3.

[26] Kellum, Paleontology and Stratigraphy of the Castle Hayne and Trent marls, Prof. Paper 143, U. S. Geol. Survey.

[27] For a good figure of *alabamensis* see Geinitz, Ueber *Nautilus Alabamensis* Morton, N. *zic-zac* Sowerby und N. *lingulatus* Von Buch Neues Jahr. fur Min. Geol. und Pal., 1887, vol. 2, p.

The Saman and Oligocene specimens porportions 1 to 4.

From the above data, the Peruvian fossils seem to divide into two groups, the earlier specimens from the Salina formation, or basal Middle Eocene, with porportional ratio quite close to the typical *A. zic-zac* of Europe; and the Upper Eocene and Oligocene specimens, more obviously related to the American *A. alabamensis* of Morton. The Salina specimens are poorly preserved and until better specimens are obtained, more detailed comparisons cannot be made. The porportions of the Upper Eocene and Oligocene specimens are quite constantly 1 to 4, and it is believed that they should be considered as a variety of *alabamensis*, which may be designated *peruviana*.

Dimensions:

Middle Eocene	Greater Diameter	Least Diameter	Semi-thickness
Salina formation			
a.	103mm.;	82mm.;	31mm.
b.	104mm.;	74mm.;	30mm.
Variety *peruviana* n. var.			
Upper Eocene			
Saman congl.	24mm.;	imperf.	6mm.
Saman sandstones	200mm.;	150mm.;	50mm.
Middle Oligocene			
Mancora formation			
(Mirador congl.)	60mm.;	45mm.;	14.5mm.
Upper Oligocene			
Heath formation			
(Cone Hill Sh.)	33mm.;	26mm.;	8.75mm.
	25mm.;	19mm.;	6.75mm.

Family NAUTILIDÆ Owen

Genus EUTREPHOCERAS Hyatt

Eutrephoceras negritensis n. sp. Plate 26, figs. 1, 2

Shell of medium size, stout, rather globose, the width or thickness of the last volution being about three-fourths the greater diameter of the whole shell; the whorls are strongly involute, but leaving a small, rather deep, narrow and partially closed umbilicus; they are moderately rounded on the venter slightly flattened on the sides and possibly slightly auriculate on the umbilical angle in full-grown individuals; the septa follow at regular intervals and with nearly straight sutures, but like those of *Eutrephoceras* possessing sometimes a shallow or nearly straight ventral lobe (usually straight in young shells), a weak ventrolateral saddle, shallow lateral lobe, a strong lateral saddle on the umbilical angle, and an umbilical lobe; the siphuncle is small and dorsocentren in position; substance of shell is rather thin, with strong, crowded, curved growth lines, convex forward on the sides and meeting on the venter to form a wide, shallow sinus.

Greater diameter 86mm.; lesser diameter 61mm.; thickness 66mm.

Remarks.— *Eutrephoceras* seems to be more typically an Upper Cretaceous Nautiloid, but in recent years, 3 or possibly 4 species have been described or referred to this genus, from the Eocene rocks of the Eastern and Southeastern part of the Coastal plain of United States. They include the *E. cookana* Whitfield[28] from the Shark River beds of New Jersey, *E. sloani* Reesides,[29] and *E. carolinensis*[30] Kellum from the Carolinas. *Enclimatoceras vaughani* described by Gardner[31] from the Midway of Texas, judging by the nearly straight suture lines should probably be referred to this genus also. *Nautilus sowerbyanus* White non d'Orb.,[32] from the Maria Farinha e Olinda beds of Pernambuco, Brazil probably belongs to this genus. As figured, White's shell resembles quite closely *negritensis,* but is more globose, the venter is even more widely rounded and the suture-lines appear to be nearly straight.

The type material of *negritensis* consists of 4 specimens collected together in the lower part of the Pale Gredas, about two miles east of Negritos.

Locality and Geologic Occurrence.— Pale Greda formation, Negritos.

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[28] Whitfield, R. P., Gasteropoda and Cephalopoda of the Raritan clays and Greensand marls of New Jersey, Mon. 18, U. S. Geol. Survey, pp. 285-286, pl. 48, fig. 1; pl. 49, figs. 4, 5.

[29] Reeside, J. B., A new nautiloid cephalopod *Eutrephoceras sloani* from the Eocene of South Carolina, Proc. U. S. Nat. Mus., Vol. 65, pp. 2-4, pls. 1, 2.

[30] Kellum, L. B., Paleontology and stratigraphy of the Castle Hayne and Trent marls in North Carolina, Prof. Paper 143, U. S. Geol. Survey, p. 32, pl. 7, figs. 5-7.

[31] Gardner J., New species of mollusca from the Eocene deposits of southwestern Texas. Prof. Paper 131-D, U. S. Geol. Survey, p. 115, pl. 33, figs. 1-3.

[32] White, C. A., Contributions to the Paleontology of Brazil, Archivos do Museu Nacional de Rio Janerio, Vol. 7, p. 230, pl. 25, figs. 1-4.

Eutrephoceras haughti n. sp. Plate 23, fig. 2

Shell small, (the type measuring about 61 mm. in maximum diameter) but moderately convex, the thickness of the last volution being about one-half the greater diameter; the whorls are strongly involute, but leaving a small, narrow, umbilicus; the last whorl is narrowly rounded on the venter, slightly flattened on the sides, and noticeably angled on the umbilical shoulder; the septa are regularly spaced with simple suture lines typical of the genus, with a nearly straight ventral lobe (if it may be so called), a ventro-lateral saddle lateral lobe, a strong lateral saddle on the umbilical shoulder and an umbilical lobe; siphuncle not visable; external surface unknown.

Greater diameter 61mm.; lesser diameter 46mm.; thickness 35mm.

Remarks.— This species differs from *negritensis*, not only by its smaller size, but is more compressed, with flattened sides and a fairly strong, umbilical angle or shoulder. The type specimen was collected by Mr. Oscar Haught near Lagunitas, probably from shales belonging to the Saman formation.

Locality and Geologic Occurrence.— Saman formation, Lagunitas.

Phylum MOLLUSCOIDEA

Class BRACHIOPODA Dumeril

Order TELOTREMATA Beecher

Superfamily TEREBRATULACEA Waagen

Family TEREBRATULIDÆ Gray

Genus LIOTHYRINA Oehlert

Liothyrina peruviana n. sp. Plate 25, figs. 2-5

Shell of medium size, moderately but not strongly convex, glabrous; dorsal valve subcircular to suborbicular, usually with a faint, broad fold showing only on the basal margin; ventral valve subelliptical, widest about the middle, with pointed beak and broady rounded basal margin; umbo full and prominent ending above in the slightly curved beak; foramen moderately large, circular.

Length 24.5mm.; breadth 23mm.; diameter 14mm.
25mm.; breadth 23mm.; diameter 14.5mm.; (type)

Remarks.— *Liothyrina peruviana* associated with a fauna of *Orthophragmina peruviana* and several special mollusks, is a common and very characteristic fossil of the base of the Upper Eocene or horizon of the Saman conglomerate in the Negritos region. It occurs at the same horizon at Lobitos and specimens have been collected near Punta Mero, associated with stellate *Orthophragmina*. In all these localities, this brachiopod has a very limited stratigraphic range, although often very common.

Several species of Terebratuloid brachiopods have been noted or described from the Upper Eocene rocks of Colombia, Trinidad, and St. Bartholomew. In the Colombian localities with which I am acquainted, they occur near the base of the Upper Eocene or at a horizon equivalent to the Peruvian.

Three species of *Liothyrina* were described by Guppy[33] from the San Fernando beds of Trinidad, as *trinitatensis, carneoides* and *lecta*. In form, *peruviana* is most like *lecta,* but is wider and more depressed. *Liothyrina vaughani* Cooke[34] from the St. Bartholomew limestones is a much larger species reaching a length of 43mm.

Localities and Geological Occurrence.— Saman formation, horizon of the Saman conglomerate, 1 mile south of Negritos, Pozo valley near Lagunitas (type locality), Lobitos, near Organo Grande, Que. Canoas near Punta Mero.

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[33] Guppy, On Tertiary Brachiopoda from Trinidad, 1866, Quart. Journ. Geol. Soc., vol. 22, p. 296, pl. 19, figs. 1-3.

[34] Cooke, Contr. to the Geology and Paleontology of the West Indies, 1919, Carnegie Institiute of Washington, pt. 4, p. 152, pl. 16, figs. 1a-c.

Printed plates furnished for the edition by the author

Explanation of Plate I

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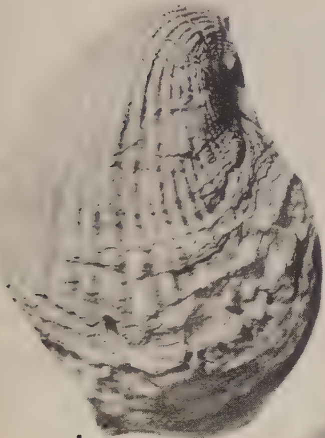
2.	**Ostrea samanensis** n. sp. Interior of same specimen, natural size.	17
3.	**Ostrea samanensis** n. sp Holotype, exterior of left valve, natural size. Casa Saman.	17
4.	**Ostrea samanensis** n. sp. Exterior of right valve, about natural size. Casa Saman	17
5.	Holotype, exterior of left valve, natural size.	



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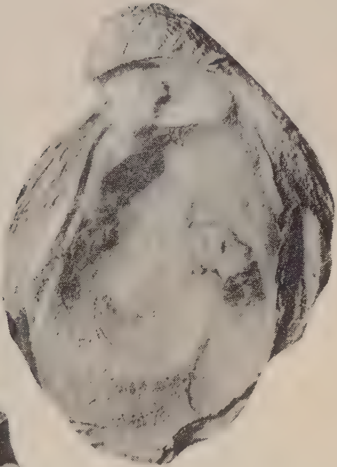

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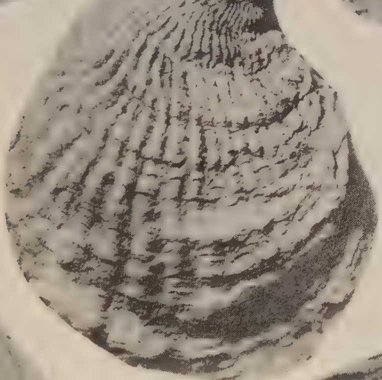

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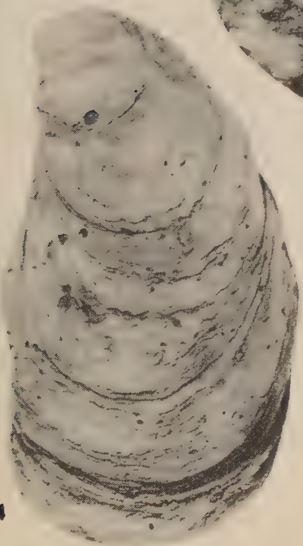

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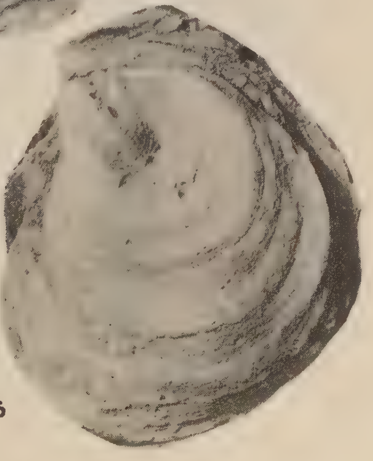

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Explanation of Plate 2

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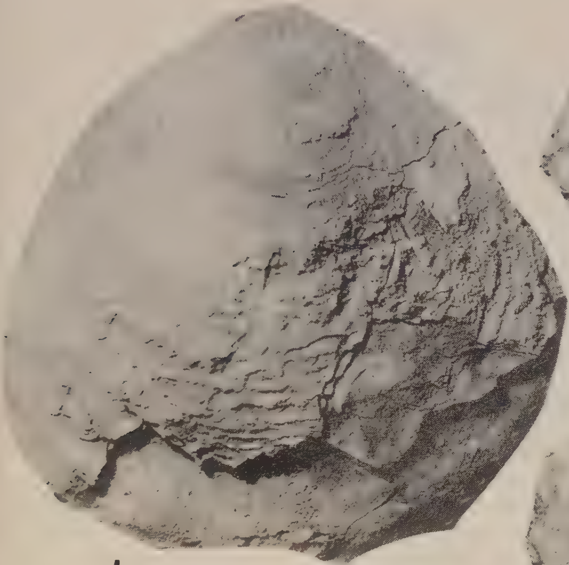

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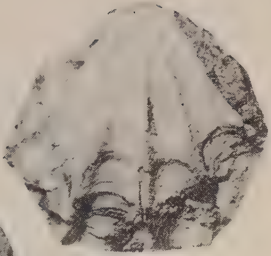

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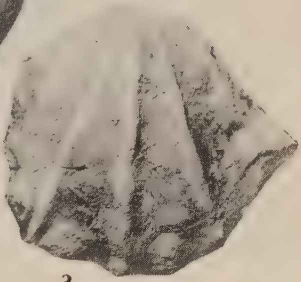

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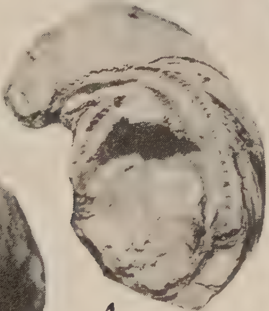

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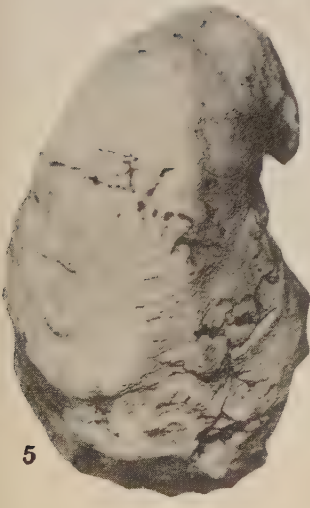

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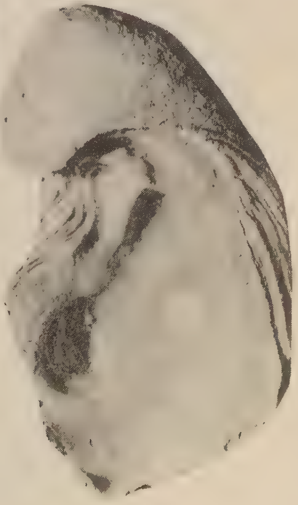

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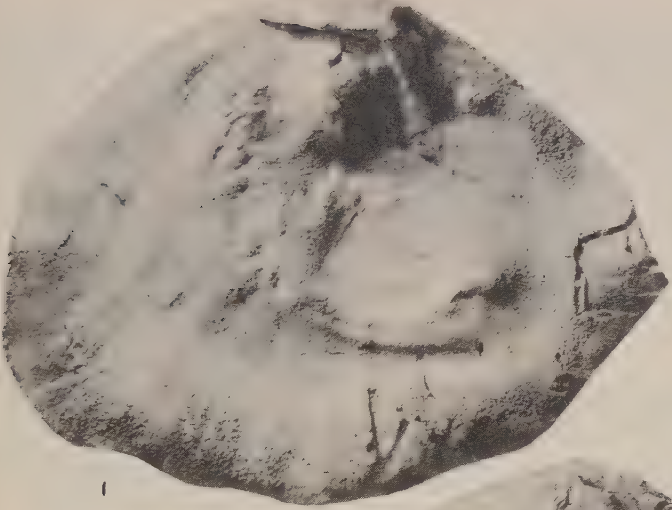
Explanation of Plate 3

Figure Page

1. **Carolia (Parinomya) parinensis** n. sp. 20
   Holotype, interior of right valve to show chondrophore, byssal foramen and adductor muscle scar.
   Parinas formation, near Negritos
2. **Carolia (Parinomya) parinensis** n. sp.
   Exterior of beak of right valve, showing the chondrophore free
3. **Carolia (Parinomya) parinensis** n. sp.
   from the dorsal-anterior margin and open byssal foramen.
   Exterior of beak of right valve with open byssal foramen
4. **Carola (Parinomya) parinensis** n. sp.
   Exterior of left valve, showing the rasp or pectinate sculpture on the anterior submargins



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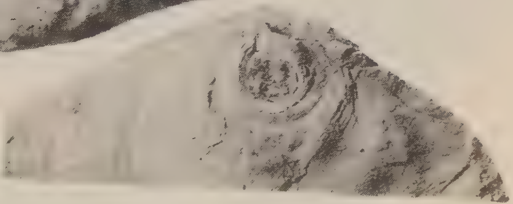

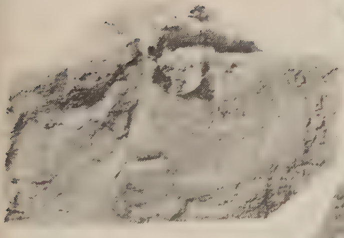

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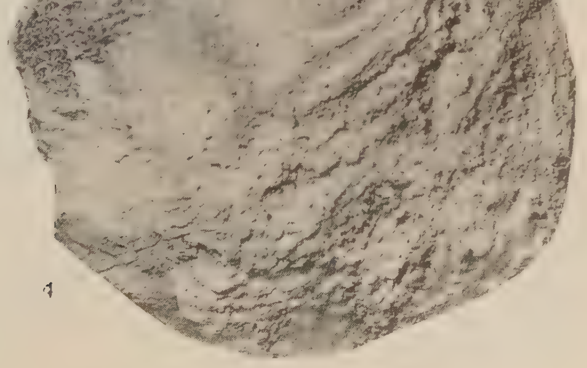

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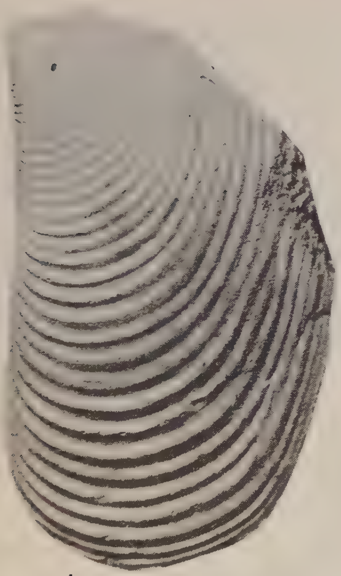
Explanation of Plate 4

Figure Page

1. **Amotapus arbolensis** Woods 22
   Exterior of left valve, about natural size
   Saman formation, Caleta Sal
2. **Amotapus arbolensis** Woods 22
   Umbonal portion of a larger specimen intended to show the straight hinge line and subregular sculpture, about natural size.
   Saman formation, Caleta Sal
3. **Atrina talarensis** n. sp. 16
   About natural size, (Holotype)
   Saman formation, Talara
4. **Mytilus euglyphus** Woods, var. **negritensis** n. var 21
   Exterior of right valve, enlarged (height 35mm.)
   Holotype, Negritos formation, Negritos
5. **Amotapus arbolensis** Woods 22
   Greatly enlarged view of a small specimen with the beak of the right valve broken away revealing the chondrophore of the right valve
   Parinas formation, Keswick Hills



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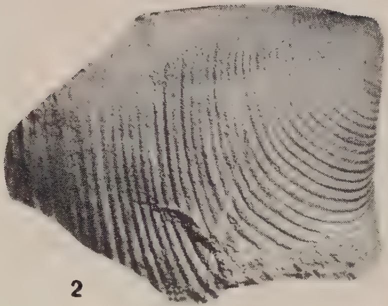

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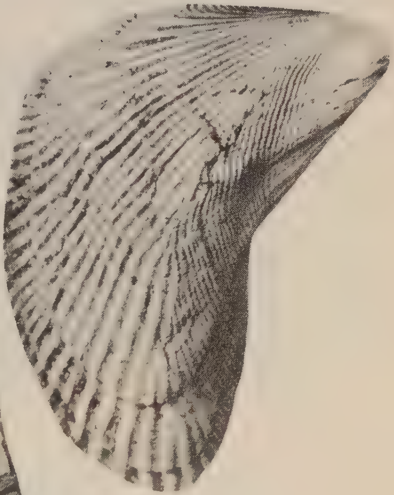

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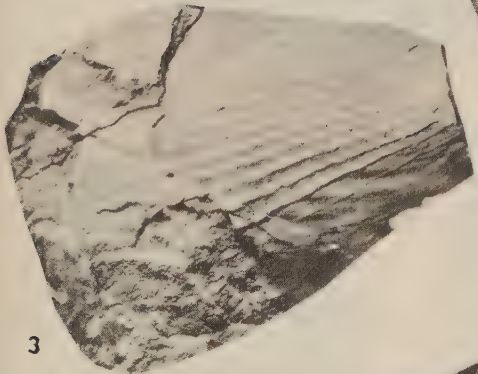

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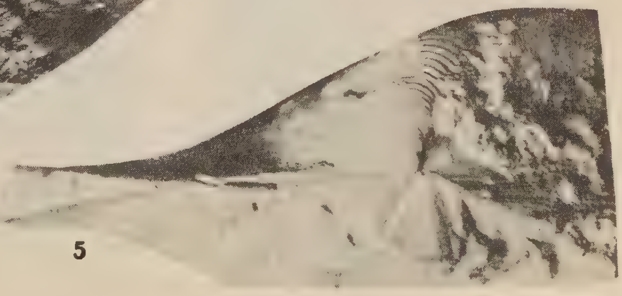

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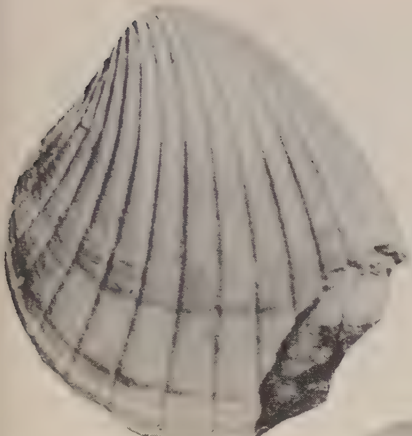

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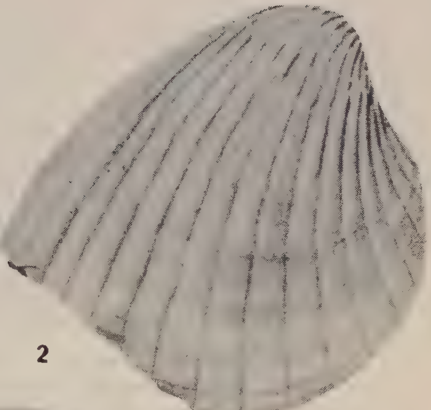

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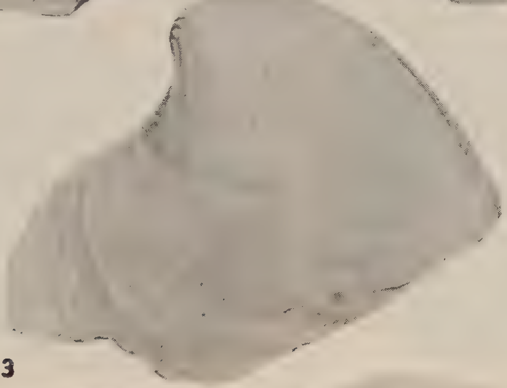

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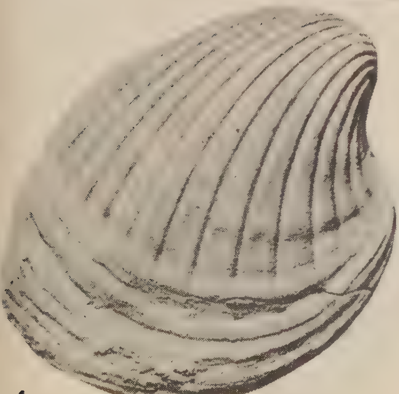

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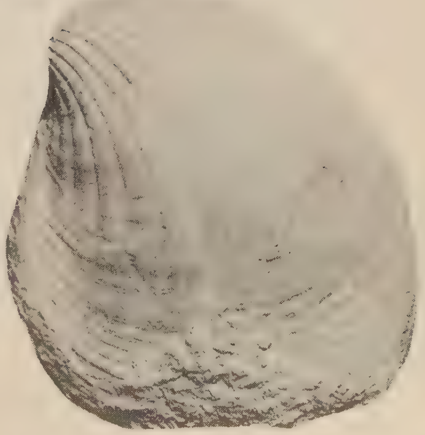

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Explanation of Plate 6

1. **Venericardia peruviana** n. sp. 29
   Holotype length 80mm.
   Salina formation, Negritos
2. **Venericardia planicosta** var. **restinensis** n. var. 27
   Holotype, length 42, height 39, semi-diameter 15.5mm.
   Restin formation, Pozo valley
3. **Venericardia pacifica** n. sp. 30
   Holotype, length 41mm.
   Salina formation, Negritos
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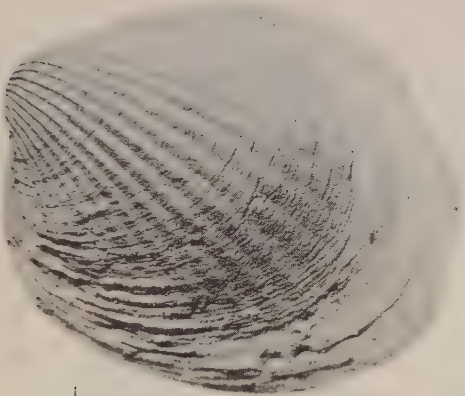
   Dorsal view of same specimen as figs. 3, 4.
6. **Venericardia planicosta** var. **samanensis** n. var. 28
   Salina formation, Saman congl., near Negritos.
   Cotype, an immature left valve, length 51mm.



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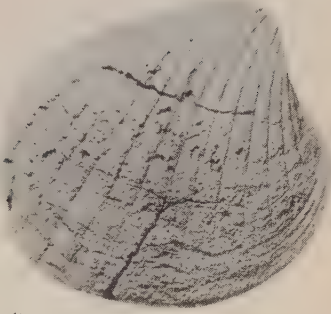

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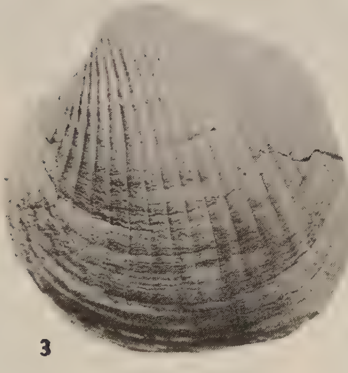

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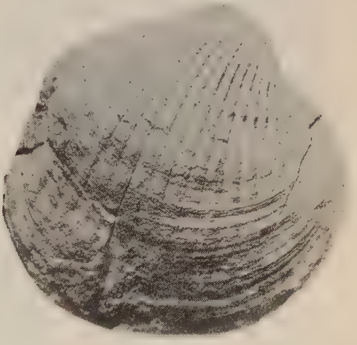

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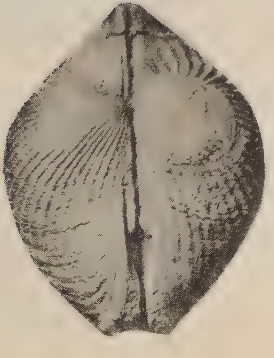

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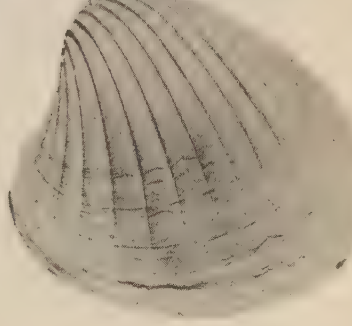

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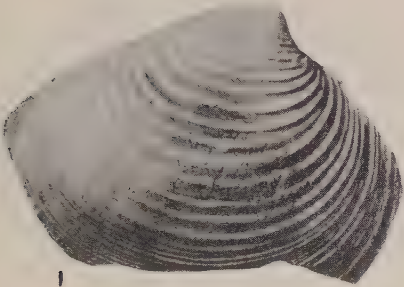
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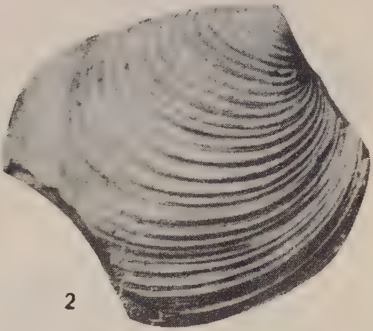
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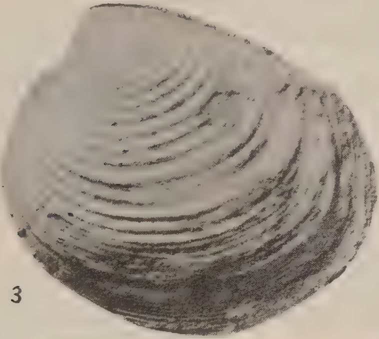
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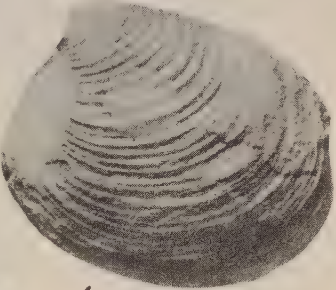
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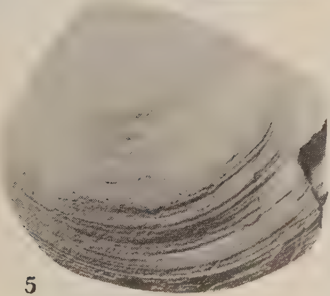
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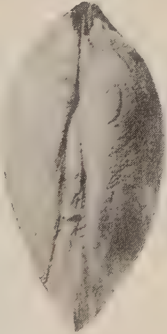
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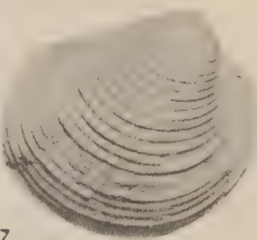
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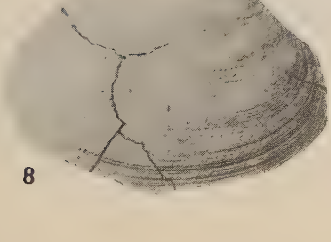
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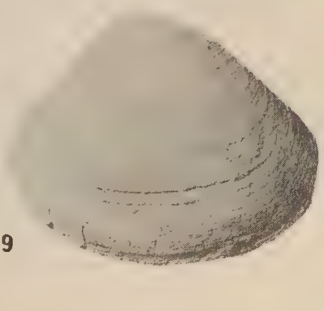
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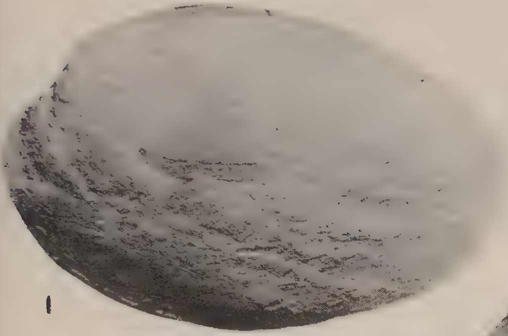
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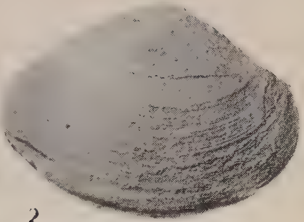
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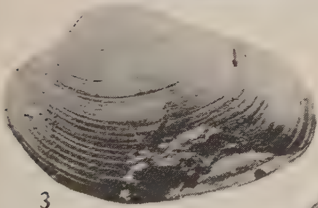
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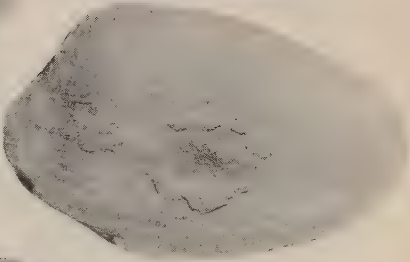
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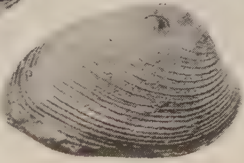
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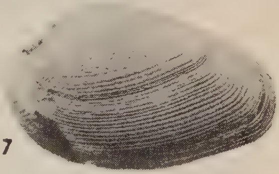
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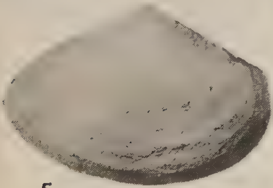
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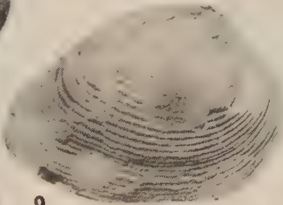
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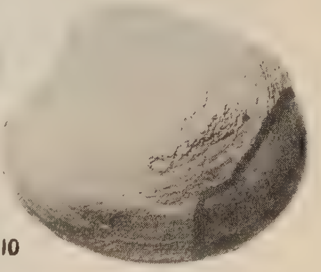
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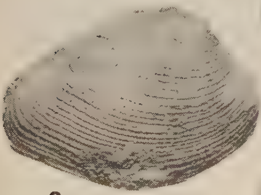
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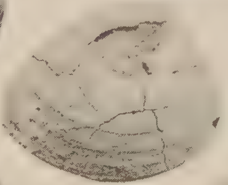
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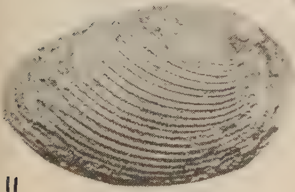
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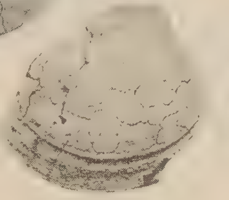
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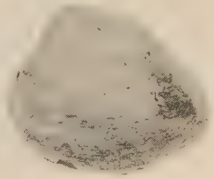
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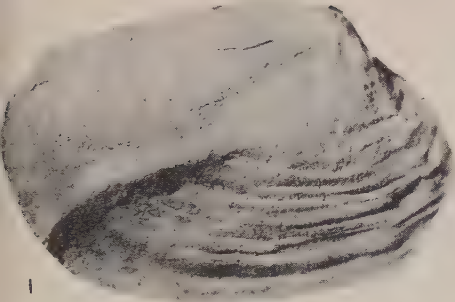
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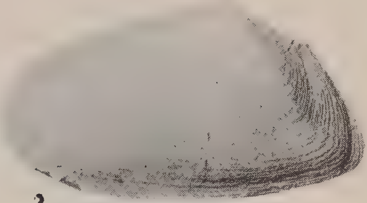
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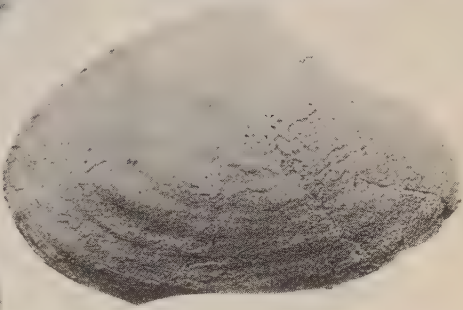
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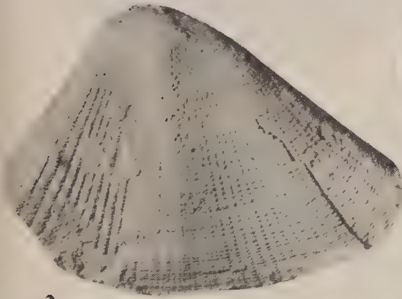
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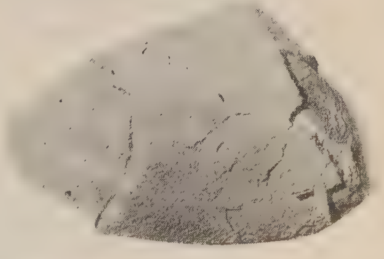
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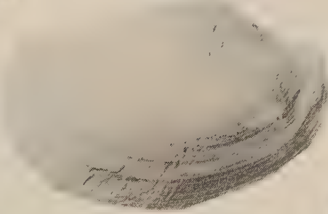
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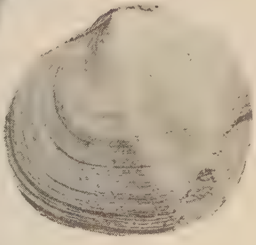

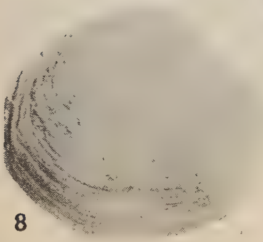
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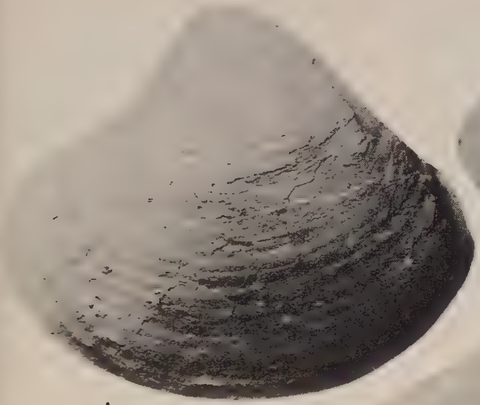
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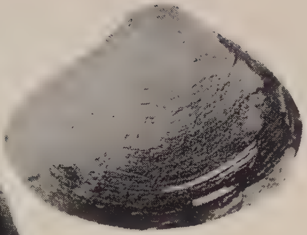
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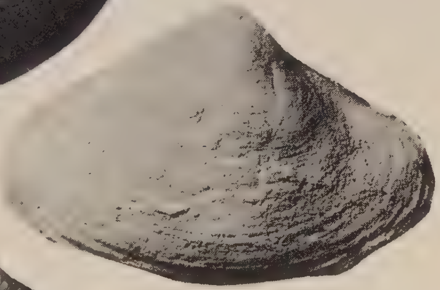
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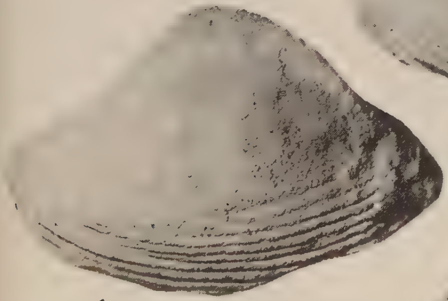
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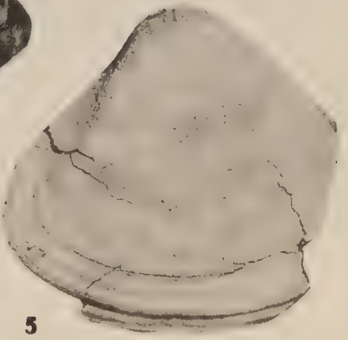
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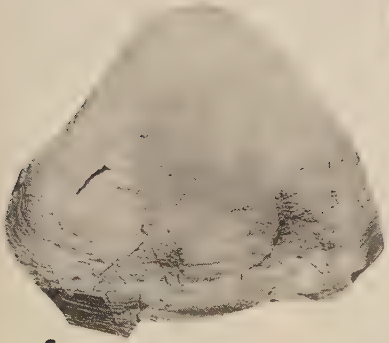
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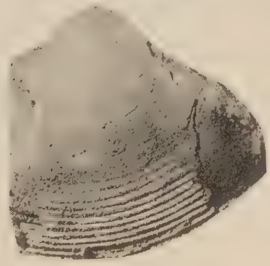
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17. **Corbula salina** n. sp. 51
Cotype, length 7.5mm.
Saman formation, Negritos

18. **Corbula boggsi** n. sp. 50
Holotype, length 8mm.
Saman formation, Negritos

19. **Corbula boggsi** n. sp. 50
Cotype, length 8mm.
Saman formation, Negritos

20. **Corbula boggsi** n. sp. 50
Cotype, length 8mm.
Saman formation, Negritos

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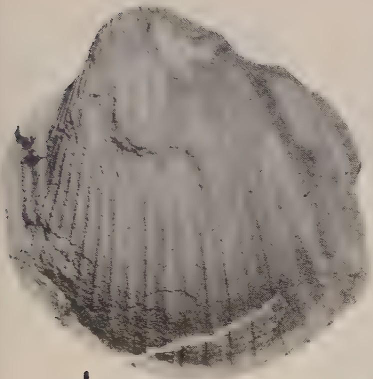
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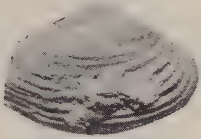
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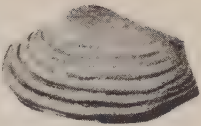
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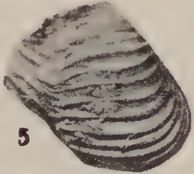
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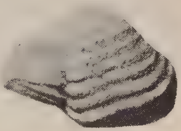
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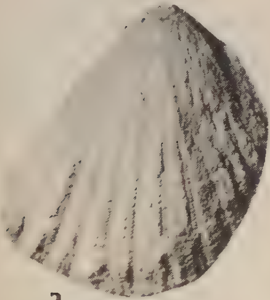
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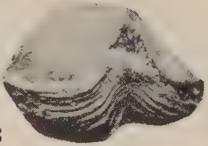
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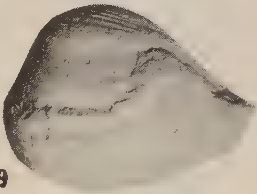
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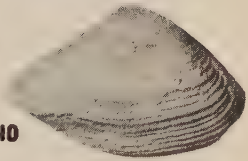
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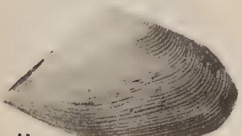
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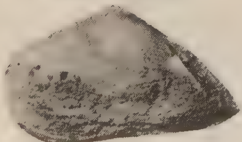
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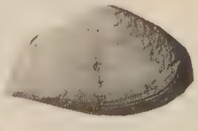
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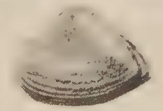
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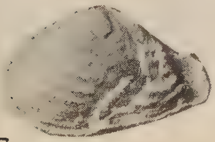
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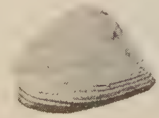
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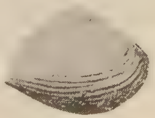
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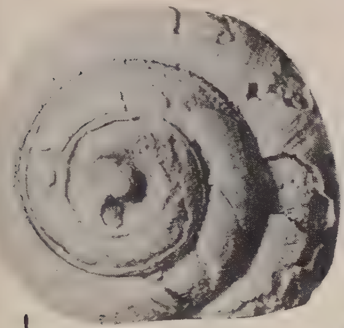
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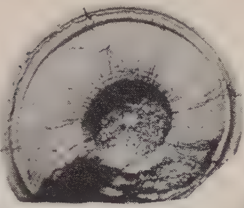
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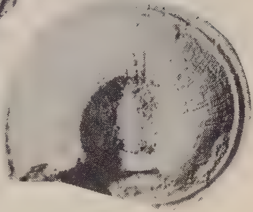
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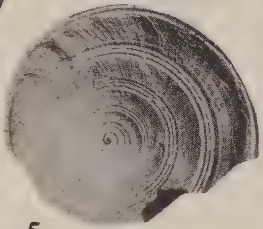
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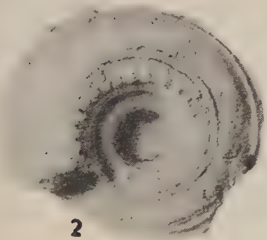
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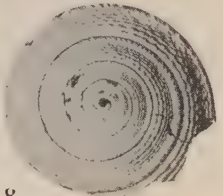
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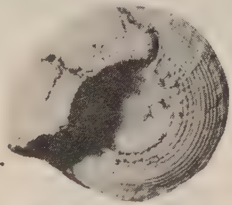

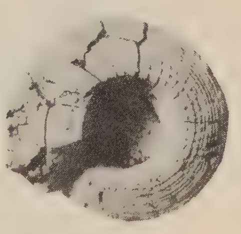

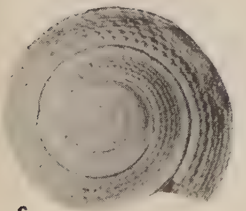
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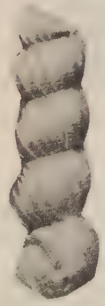
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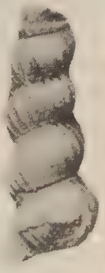

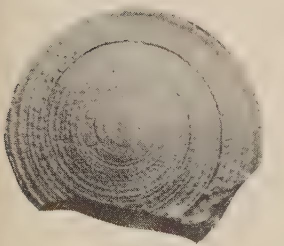
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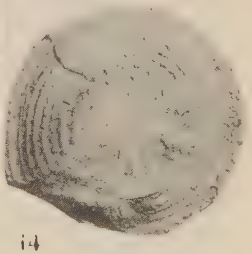
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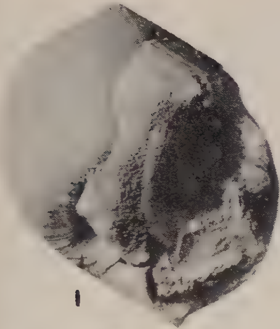
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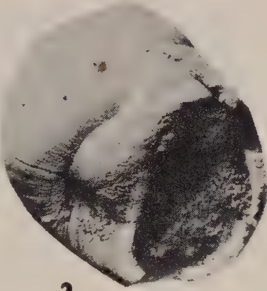
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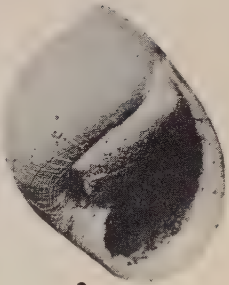
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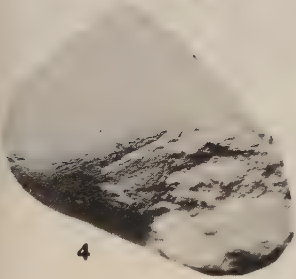
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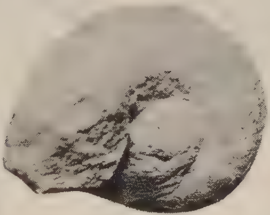
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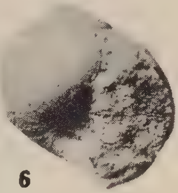
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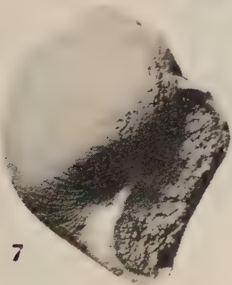
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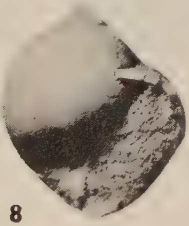
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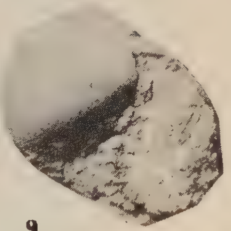
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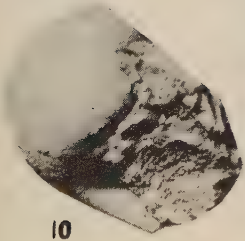
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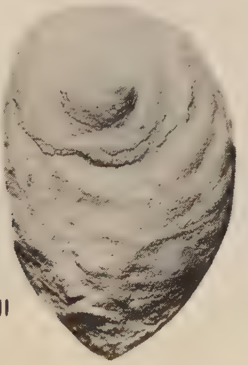
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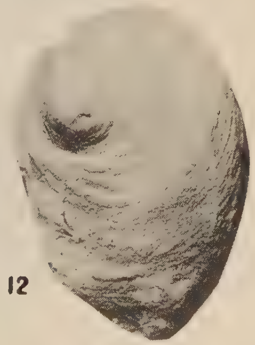
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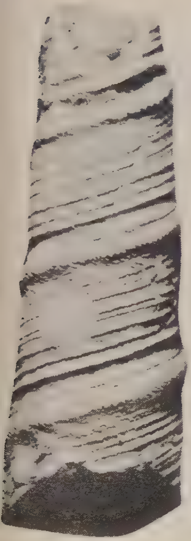
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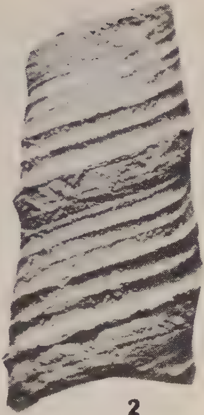
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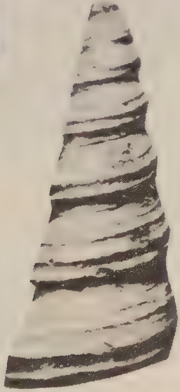
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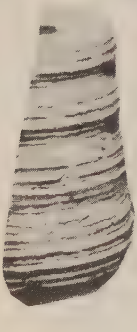
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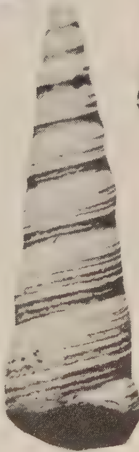
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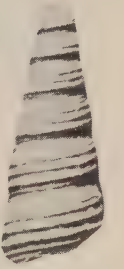
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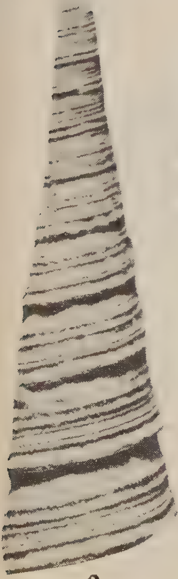
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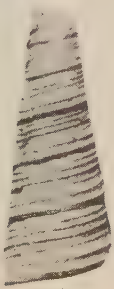
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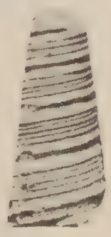
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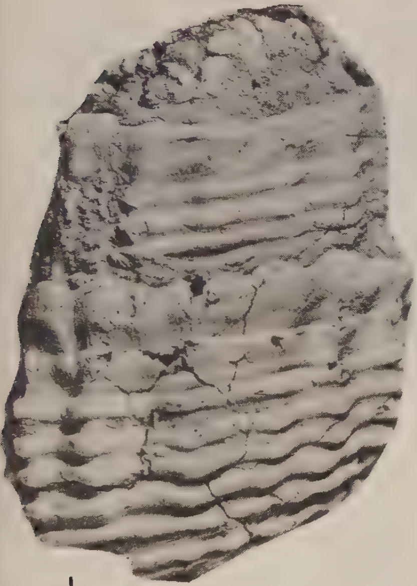

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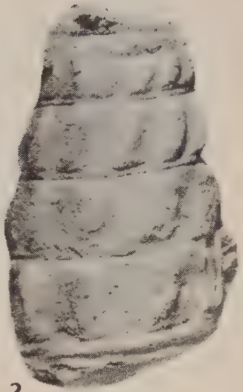

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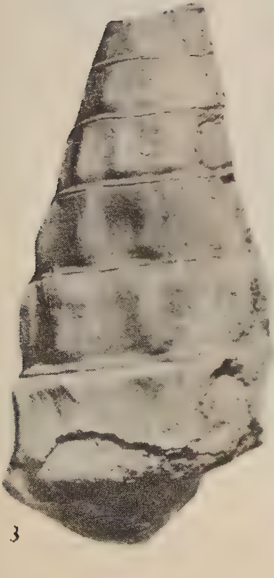

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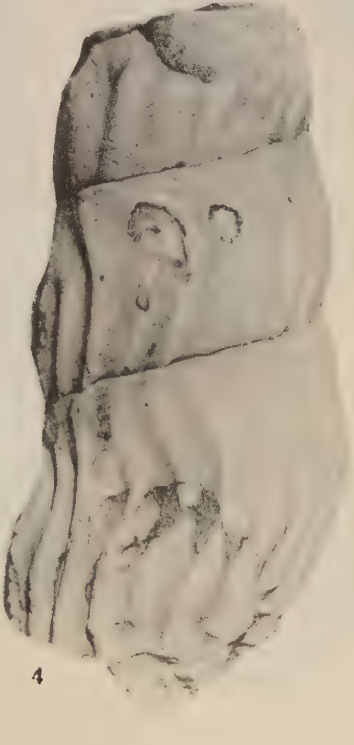

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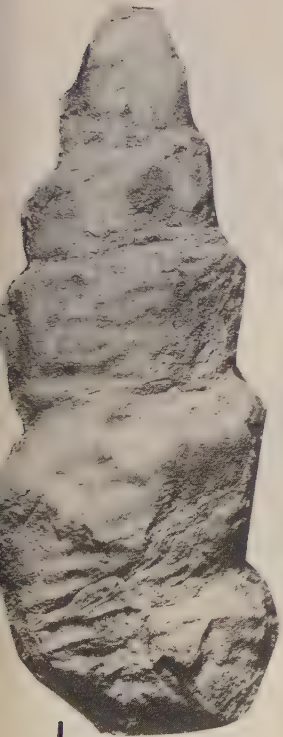

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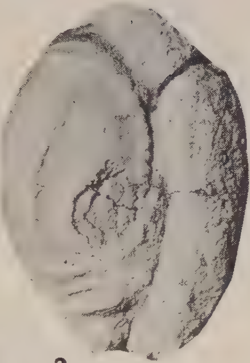

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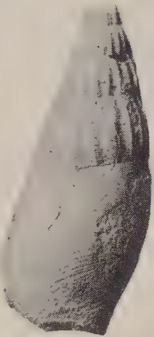

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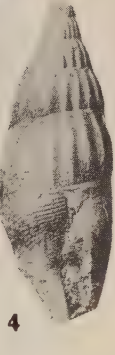

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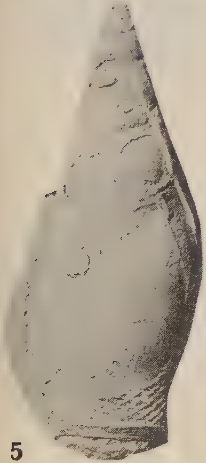

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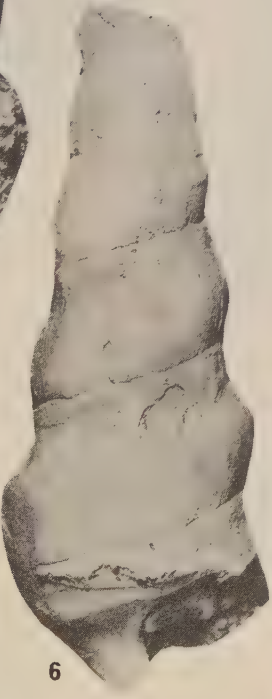

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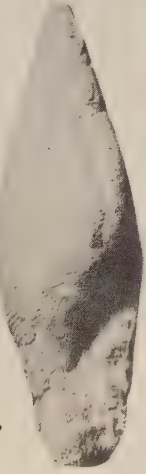

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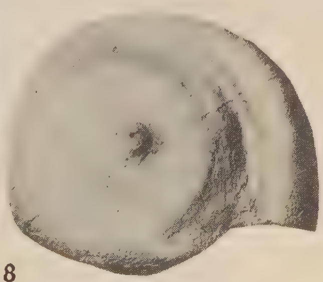

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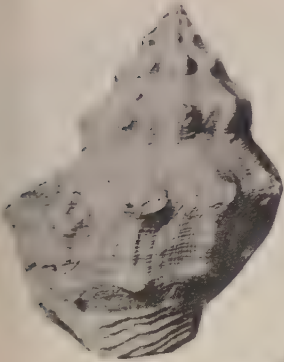
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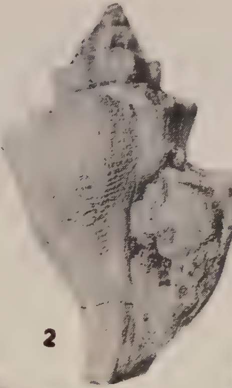
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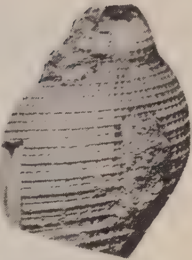
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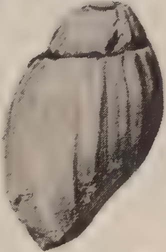
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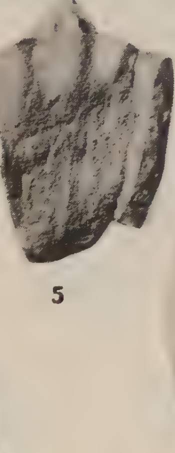
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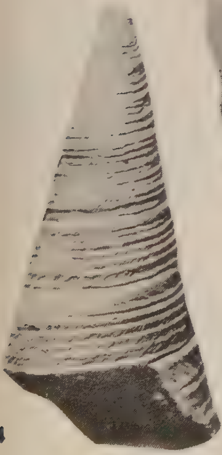
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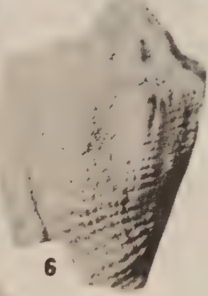
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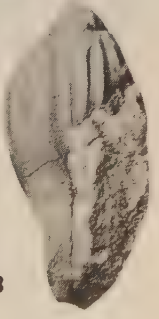
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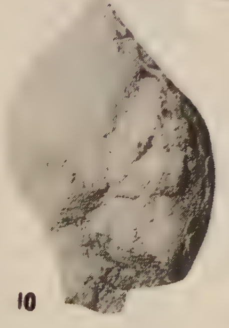
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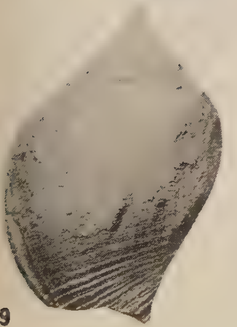
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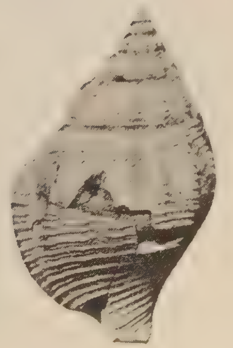
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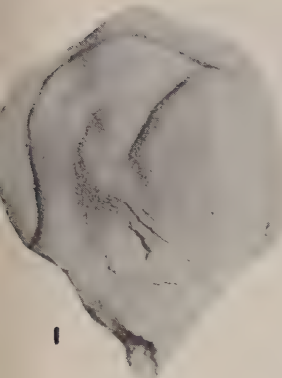
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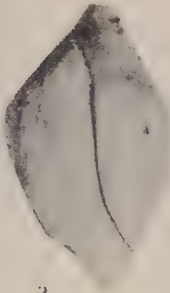
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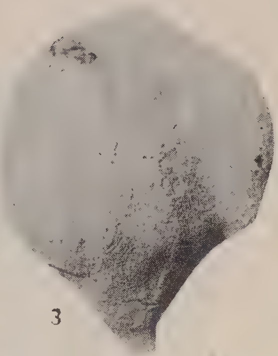
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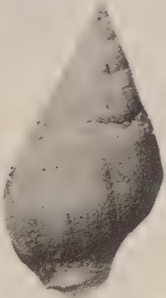
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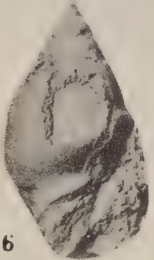
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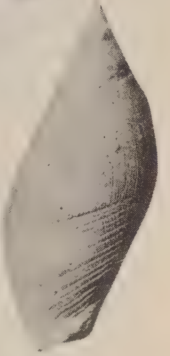
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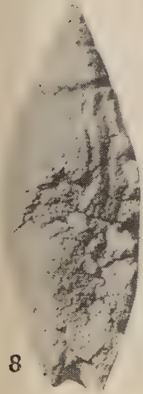
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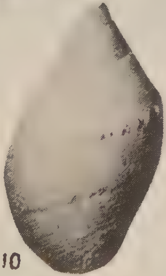
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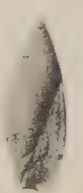
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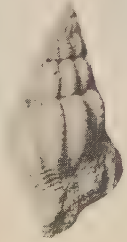
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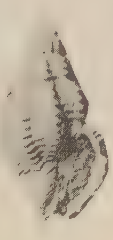
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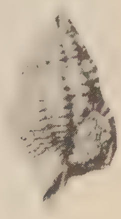
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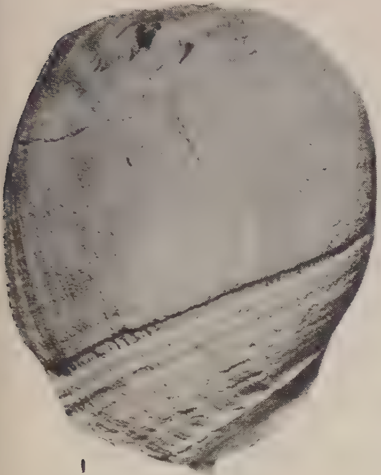
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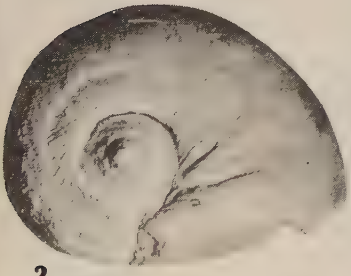
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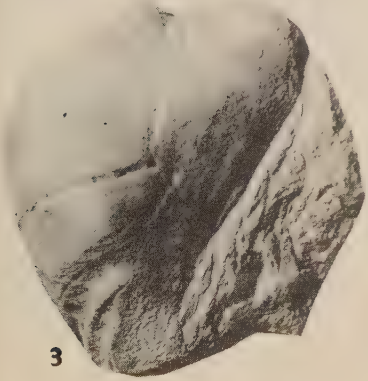
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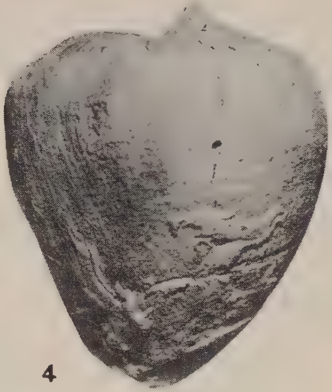
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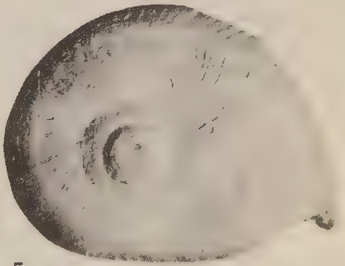
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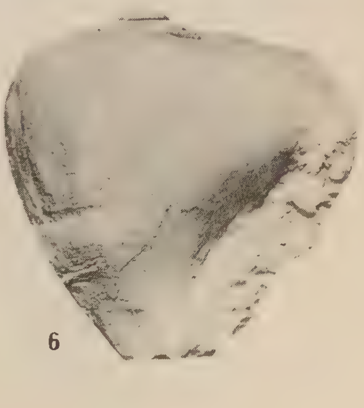
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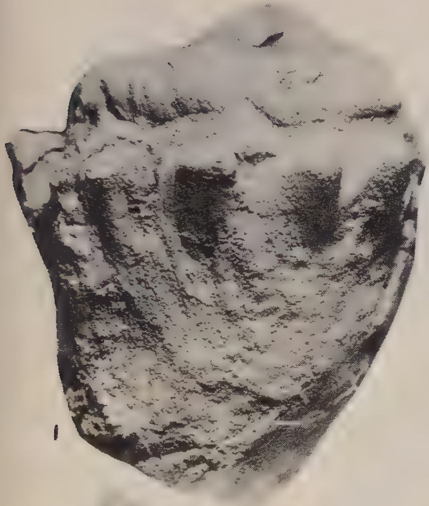
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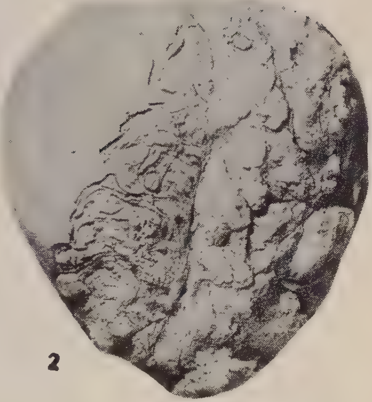
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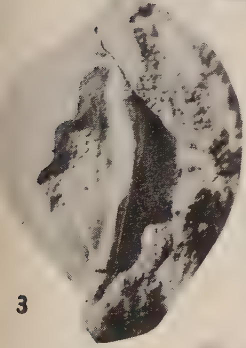
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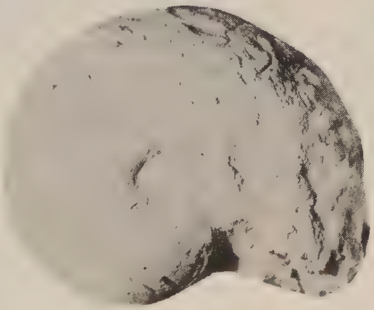
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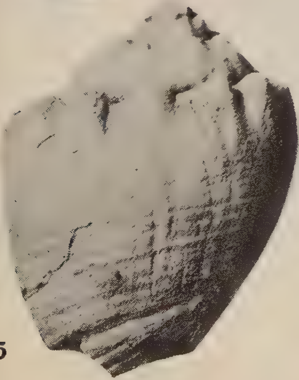
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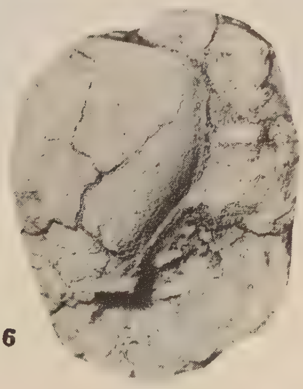
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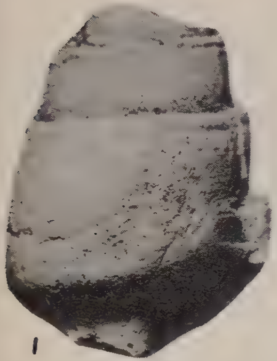

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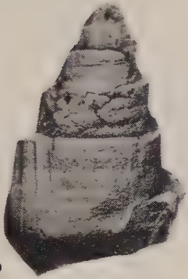

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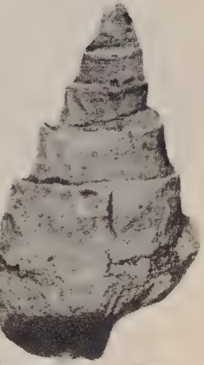

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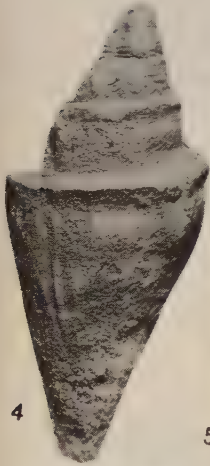

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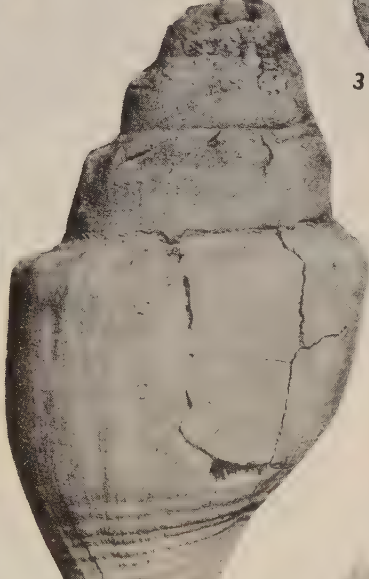

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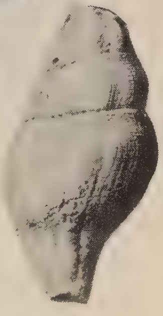

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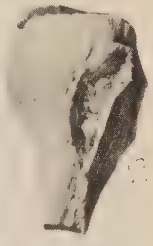

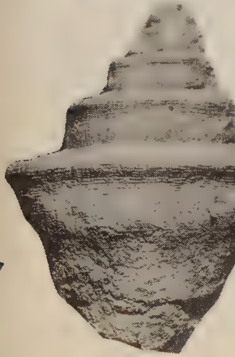

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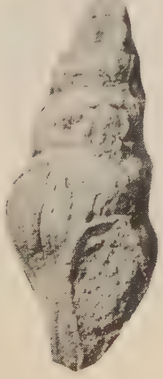

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Explanation of Plate 22

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1. **Voluta (Peruluta) mancorensis** n. sp. 92
   Holotype, ventral view, about natural size.
   Saman formation, Casa Saman.
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   Cotype, dorsal view of a specimen about natural size.
   Casa Saman.
3. **Voluta (Peruluta) mancorensis** n. sp. 92
   Cotype, ventral view showing large columellar folds.
   Casa Saman.
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   Saman formation, horizon of the Saman congl., near Negritos.
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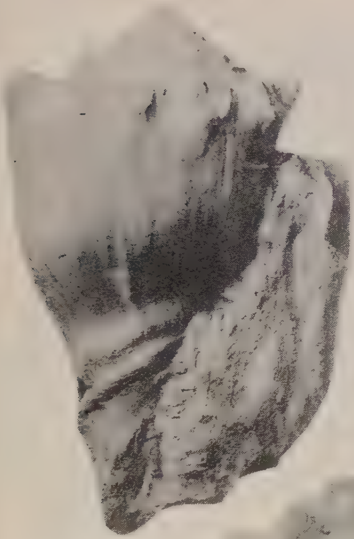
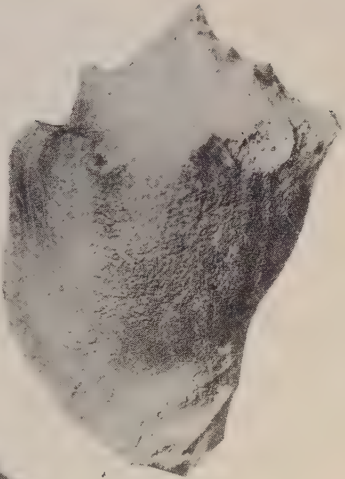
   Saman congl., near Negritos.





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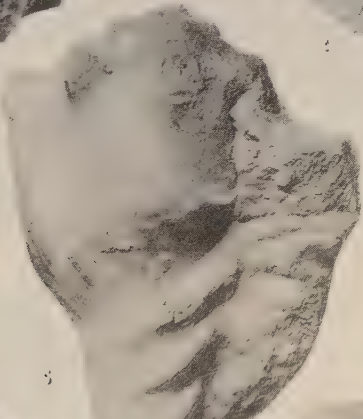

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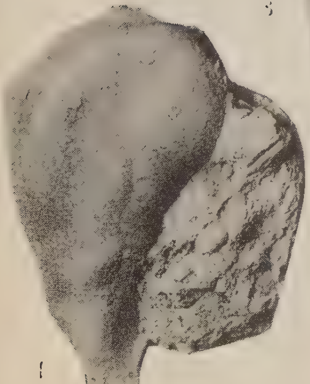

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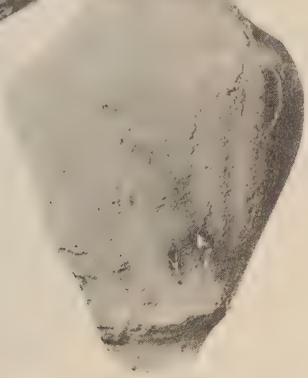

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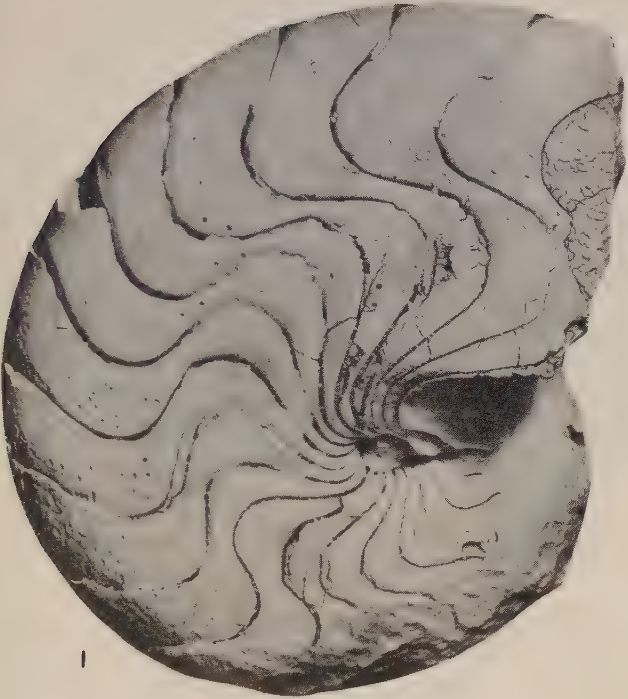
Explanation of Plate 23

Figure Page

1. **Hercoglossa peruviana** Berry 96
   Topotype, young specimen, height 87mm.
   Restin formation, Lobitos.

2. **Eutrephoceras haughti** n. sp. 101
   Holotype, greater diameter 61mm.
   Saman formation, Lagunitas.



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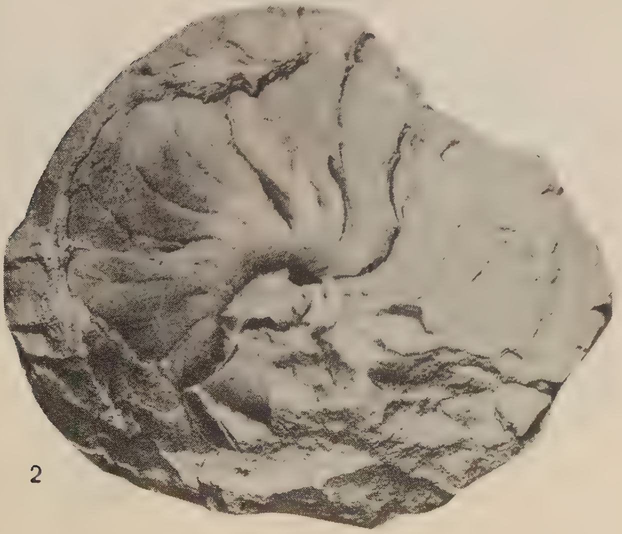

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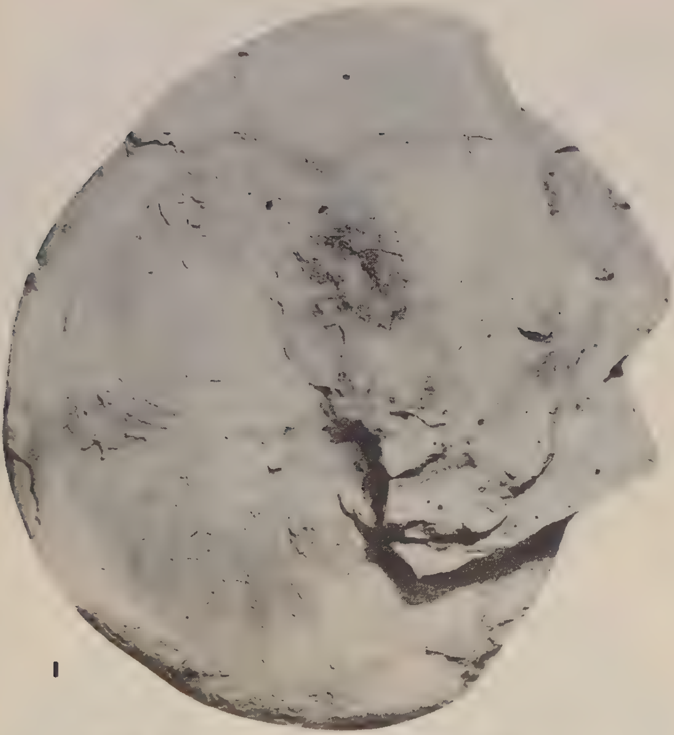
Explanation of Plate 24

1. **Aturia alabamensis** var. **peruviana** n. var. 99
   Holotype, greater diameter 200mm.
   Saman formation, Casa Saman.
2. **Aturia alabamensis** var. **peruviana** n. var. 99
   Heath formation, Cone Hill shales near Tamarindo, Chira valley,
   Height or greater diameter 34 mm.
3. **Aturia alabamensis** var. **peruviana** n. var. 99
   Fragmentary specimen showing the characteristic suture lines.
   About natural size.
   Saman formation, Near Lagunitas.



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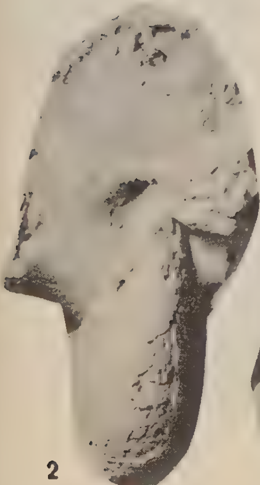

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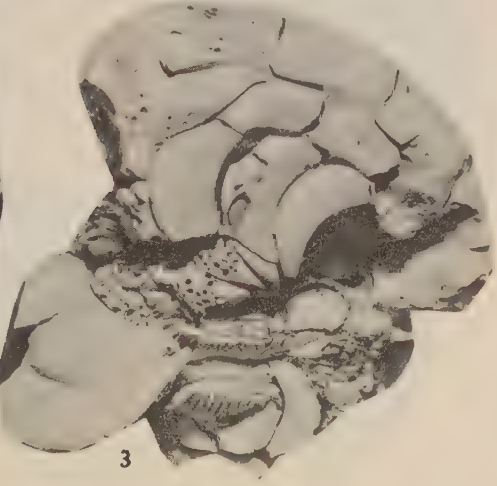

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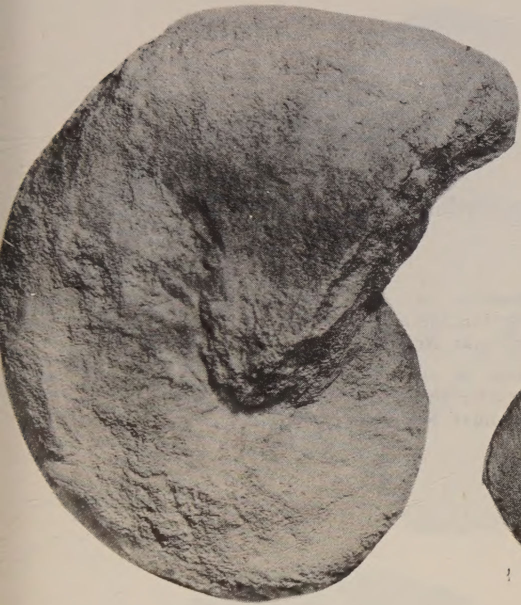
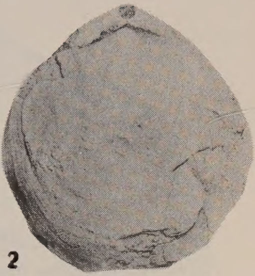
Explanation of Plate 25

Figure		Page
1.	**Aturia cf. zic-zac Sowerby** Greater diameter about 100mm. Salina formation, Negritos	96
2.	**Liothyrina peruviana n. sp.** Holotype, height 25mm. Saman formation, Saman congl., near Lagunitas.	101
3. 4.	**Liothyrina peruviana n. sp.** Cotype, height 24mm. Same locality as last.	101
5.	**Liothyrina peruviana n. sp.** Cotype, height 22.5mm. Same locality as last.	101
6.	**Aturia cf. zic-zac Sowerby** Same specimen as fig. 1.	96





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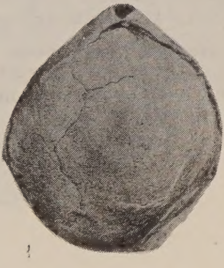

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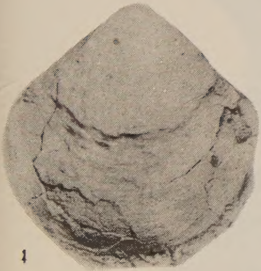

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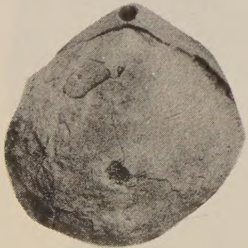

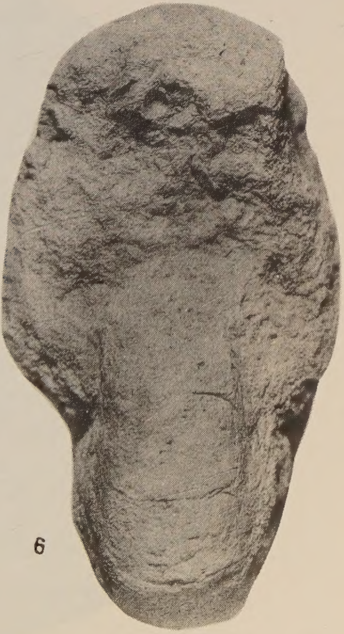

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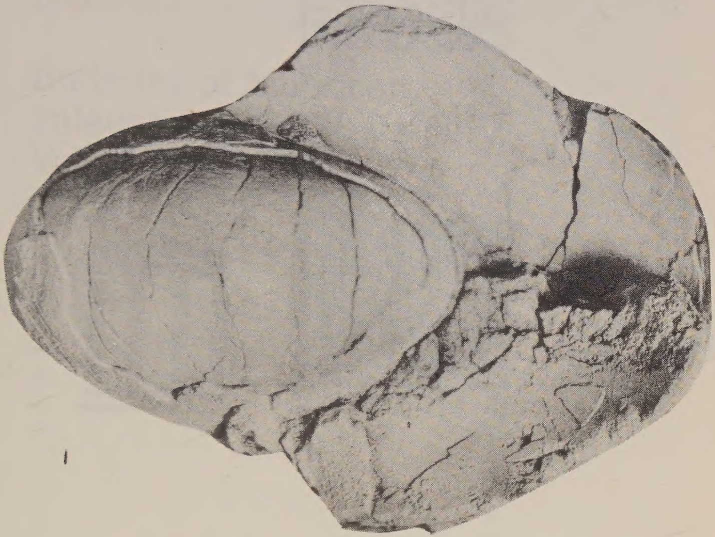
Explanation of Plate 26

1. **Eutrephoceras negritensis** n. sp. 99
   Holotype, greater diameter 86mm.
   Pale Greda formation, near Negritos.
2. **Eutrephoceras negritensis** n. sp. 99
   Holotype, greater diameter 86mm.
   Pale Greda formation, near Negritos.



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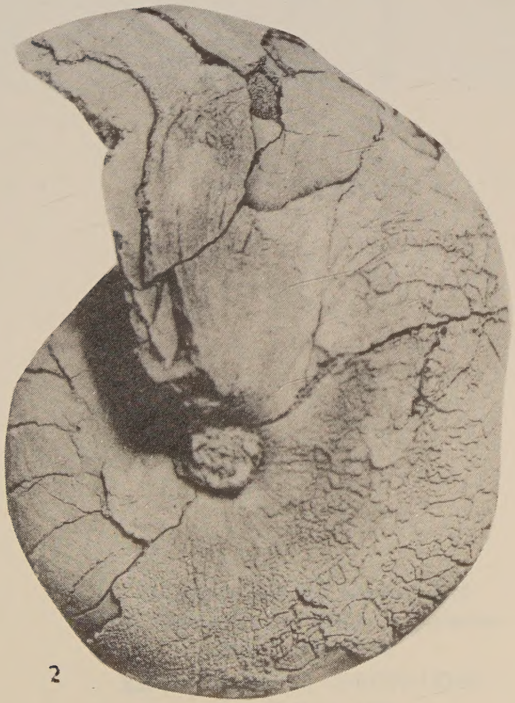

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